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CHARACTERIZATION OF EMISSIONS FROM ADVANCED AUTOMOTIVE POWER PLANT CONCEPTS

by

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16. ABSTRACT

Emissions from three diesel cars using two fuel formulations were assessed. The three diesel cars included a prototype naturally-aspirated Fiat 131, a prototype turbocharged Fiat 131, and a 1981 Oldsmobile Cutlass Supreme. Each Fiat was tested with and without a prototype catalytic trap. Vehicle operating procedures used for test purposes included the 1981 Federal Test Procedures as well as the Highway Fuel Economy Test, the New York City Cycle, and an 85 km/hr steady-state cruise. Both regulated and unregulated gaseous and particulate emissions were measured. Organic solubles in particulate were analyzed for various constituents and characteristics including fractionation by relative polarity, benzo(a)pyrene (BaP), and mutagenic activity by Ames bioassay.

Application of the catalytic trap oxidizer system to the Fiat prototypes resulted in significant reductions of organic and carbon monoxide emissions under all transient driving conditions examined. Total particulate emissions were reduced an average of 55 percent with the turbocharged engine and 65 percent with the naturally-aspirated engine. The Ames assay mutagenic response (revertants/μg) of the particulate phase organics was elevated by the catalytic exhaust aftertreatment device, however the emission rates (revertants/km) were reduced an average of 66 percent with the turbocharged and 73 percent with the naturally-aspirated engines.

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PREFACE

This project was conducted for the U.S. Environmental Protection Agency by the Department of Emissions Research, Southwest Research Institute. The laboratory testing phase of the work began in April 1977, and was completed in December 1981. This project was conducted under EPA Contract No. 68-02-2703, and was identified within Southwest Research Institute as Project Number 05-4874-001. The EPA Project Officer was Dr. Ronald L. Bradow of the Mobile Source Emissions Research Branch, Environmental Protection Agency, Research Triangle Park, North Carolina. The Southwest Research Institute Project Manager was Charles T. Hare, who also acted as Project Leader from the inception of the project to March 1981. The Project Leader from March 1981 to December 1981 was Daniel A. Montalvo. Karl J. Springer was overall supervisor of the effort.

Many of the analytical procedures used in this program for characterizing the unregulated emissions were developed and validated earlier in the program. Methods of collection and analyses for aldehydes and ketones, hydrogen cyanide and cyanogen, hydrogen sulfide, carbonyl sulfide and organic sulfides, ammonia, organic amines, nitrous oxide, sulfur dioxide, individual hydrocarbons, and phenols were studied in detail. Interference studies and proof-tests in diesel engine exhaust were conducted with each procedure. Qualification tests were conducted by introducing known quantities of these pollutants into the exhaust of a diesel engine operating on a standard emissions test CVS tunnel. The development and validation of the analytical procedures began in April, 1977 and were completed January 1980. The results of these

experiments were published April 1980 in EPA report, "Analytical Procedures for Characterizing Unregulated Emissions from Vehicles Using Middle-Distillate Fuels, Interim Report," EPA-600/2-80-068.

We would like to express our appreciation to Mr. B. E. Enga and Mr. M. F. Buchman of Johnson-Matthey Company in Wayne, Pennsylvania for their assistance in supplying the catalytic traps used in this project, as well as suggestioned regeneration techniques. Appreciation is also expressed to Dr. Rinaldo Rinolfi of Fiat, Italy, for his help in supplying engine specifications to enable proper catalytic trap installation.

The prototype naturally-aspirated and turbocharged Fiat 131 diesels used in this project were received from Fiat (Italy) for their initial study at the Department of Transportation, Transportation Systems Center (DOT/TSC), Cambridge, Massachusetts. The emissions studies at DOT/TSC were under sponsorship of the United States Department of Energy as managed by NASA Lewis Research Center under Interagency Order C-32817-D. Prior to their shipment to SwRI, the vehicles were also studied at the Department of Energy, Bartlesville Energy Technology Center, Bartlesville, Oklahoma. We gratefully acknowledge the cooperation of Fiat (Italy), DOT/TSC, and the Bartlesville Energy Technology Center in supplying the vehicles and relevant emissions data for use in this program.

ABSTRACT

Emissions from three diesel cars using two fuel formulations were assessed. The three diesel cars included a prototype naturally-aspirated Fiat 131, a prototype turbocharged Fiat 131, and a 1981 Oldsmobile Cutlass Supreme. Each Fiat was tested with and without a prototype catalytic trap. Vehicle operating procedures used for test purposes included the 1981 Federal Test Procedure as well as the Highway Fuel Economy Test, the New York City Cycle, and an 85 km/hr steady-state cruise. Both regulated and unregulated gaseous and particulate emissions were measured. Organic solubles in particulate were analyzed for various constituents and characteristics including fractionation by relative polarity, benzo(a)pyrene (BaP), and mutagenic activity by Ames bioassay.

Application of the catalytic trap oxidizer system to the Fiat prototypes resulted in significant reductions of organic and carbon monoxide emissions under all transient driving conditions examined. Total particulate emissions were reduced an average of 55 percent with the turbocharged engine and 65 percent with the naturally-aspirated engine. The Ames assay mutagenic response (revertants/μg) of the particulate phase organics was elevated by the catalytic exhaust aftertreatment device, however the emission rates (revertant/km) were reduced an average of 66 percent with the turbocharged and 73 percent with the naturally-aspirated engines.

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I. INTRODUCTION

Continuing concern for diminishing worldwide petroleum supplies has prompted a renewed interest in more efficient engine designs as alternates to gasoline engines now in wide use. Advanced-concept engines initially considered for emissions and fuel economy studies in this program were gas turbines, Stirling cycle, turbocharged and naturally-aspirated diesels, Rankine cycle, stratified charge, and advanced Otto-cycle. Actual engine availability only permitted evaluation of a prototype naturally-aspirated diesel, a prototype turobcharged diesel, and a 1981 regular production naturally-aspirated diesel. Each prototype diesel was also evaluated with catalytic trap. A "National Average" No. 2 fuel served as the "primary fuel" or base fuel. Although a "wide boiler" was initially considered as a "second" fuel, it became apparent that the test vehicles would need a higher-cetane distillate to run well. Consequently, a "second" fuel which is bascially a No. 2 home heating oil was chosen to provide a "worst case" comparison.

Because all exhaust emissions have a potential impact on the public health, the study reported here also measured a substantial number of unregulated exhaust emissions along with the regulated emissions (HC, CO, NO_x, and particulate). Dynamometer driving schedules used in the study included the 1981 Federal Test Procedure(1)* (3-bag FTP), 4-bag FTP (cold 23-minute FTP plus hot 23-minute FTP), Highway Fuel Economy Test(2) (HFET), New York City Cycle(3) (NYCC), 85 km/hr steady-state, and the "cold 505" (first 505 seconds of a cold-start FTP, used for smoke evaluation only).

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*Superscript numbers in parentheses designate references at end of report.

II. SUMMARY AND CONCLUSIONS

The major purpose of this project was to evaluate many different emissions during dynamometer operation of a prototype naturally-aspirated Fiat 131 diesel with and without catalytic trap, a prototype turbocharged Fiat 131 diesel with and without catalytic trap, and a 1981 regular production Oldsmobile Cutlass diesel. Transient and steady-state cycles incorporated into the study were the 3-bag FTP, 4-bag FTP, HFET, NYCC, 85 kph and cold 505. All test vehicles were operated using a "National Average" No. 2 fuel (SwRI Code EM-329-F) and a Couch No. 2 fuel (SwRI Code EM-469-F) which is basically a home heating oil.

The overall evaluations were planned principally to collect a substantial amount of information on regulated and unregulated emissions, with minimum repetitive testing. The total number of tests completed with the five vehicle configurations was still very extensive, however, including 36 sequences consisting of a 4-bag FTP, HFET, NYCC, and 85 kph cycle each. In addition, more than 138 supplementary tests were also completed consisting of ten 4-bag FTP's, thirty hot FTP's, seventeen HFET's, thirty-nine NYCC's, twenty-five 85 kph's, seventeen cold 505's, and various trap regeneration tests.

An important finding in this project was the success of the catalytic traps in significantly reducing various regulated and unregulated organic emissions of the naturally-aspirated and turbocharged Fiats. A good illustration of the trap oxidizer effectiveness in organic emissions control is provided in Figures 1 through 4, where emissions of soluble organic fraction (SOF), individual hydrocarbons (IHC), aldehydes and ketones, and phenols are compared to HFID total hydrocarbons. Figure 1 indicates how the FTP emissions

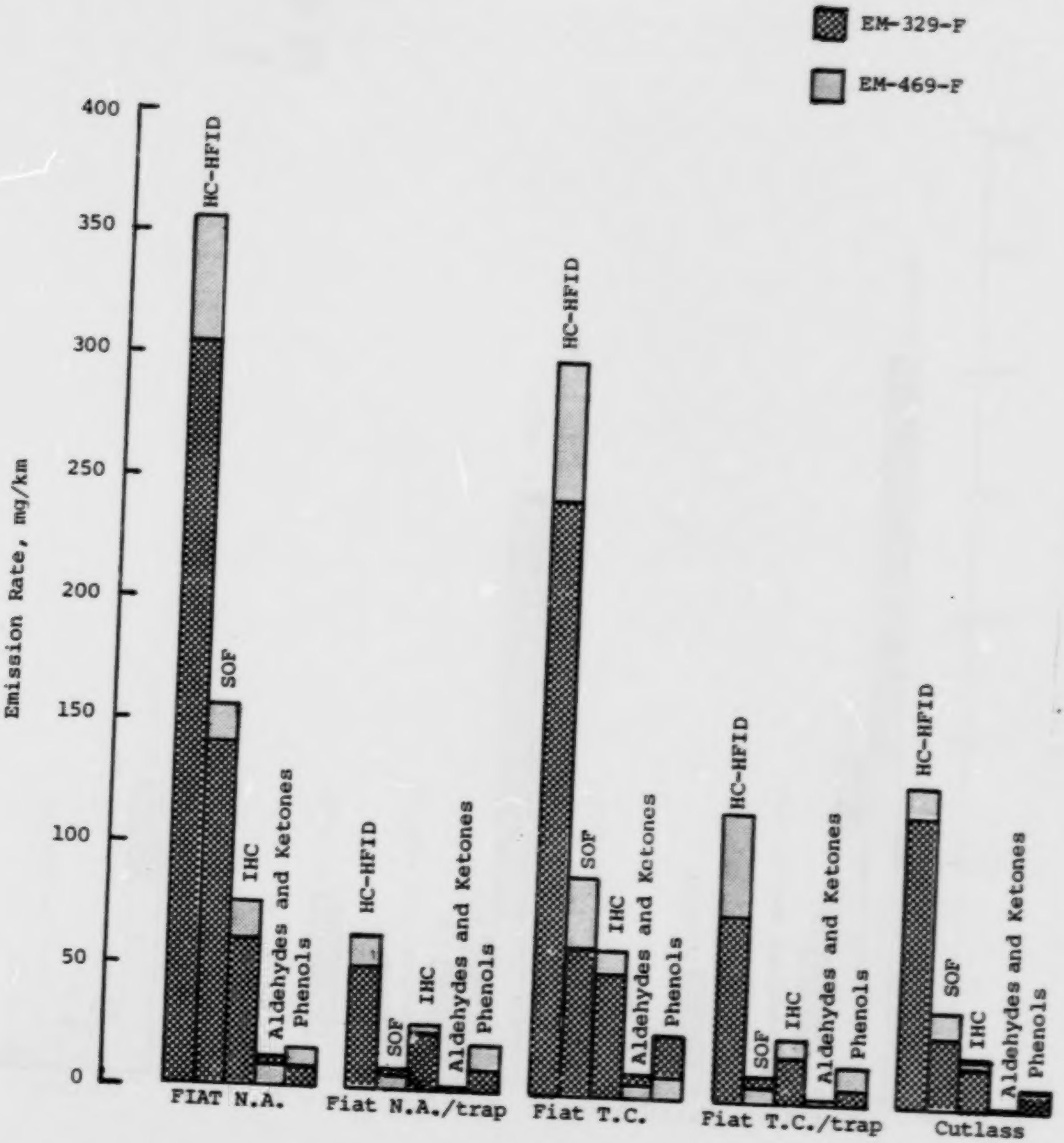


Figure 1. FTP organic emissions of Fiat N.A., Fiat T.C., and 1981 Oldsmobile Cutlass diesel vehicles with EM-329-F and EM-469-F fuels.

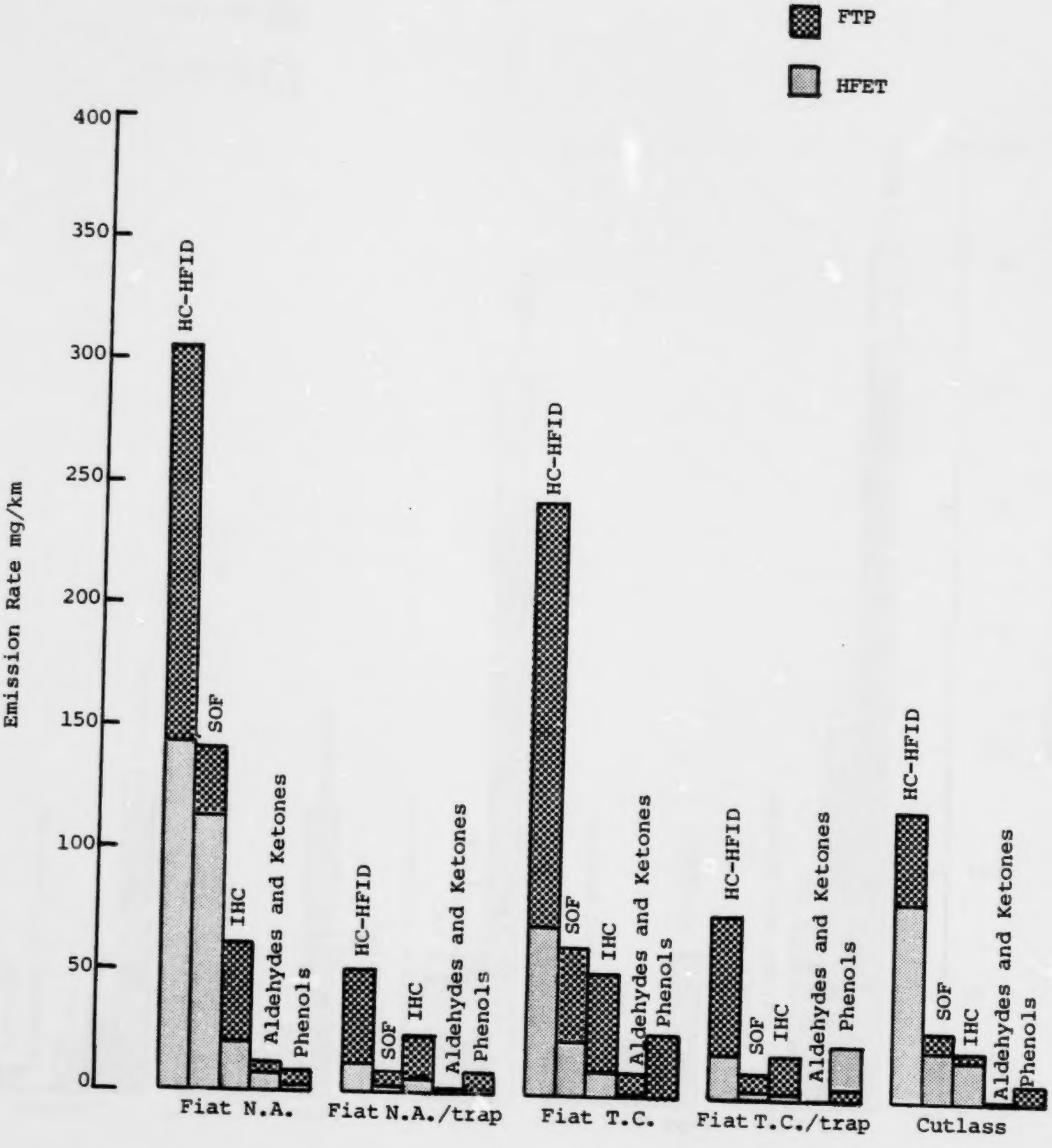


Figure 2. FTP and HFET organic emissions of Fiat N.A., Fiat T.C., and 1981 Oldsmobile Cutlass diesel vehicles with EM-329-F fuel.

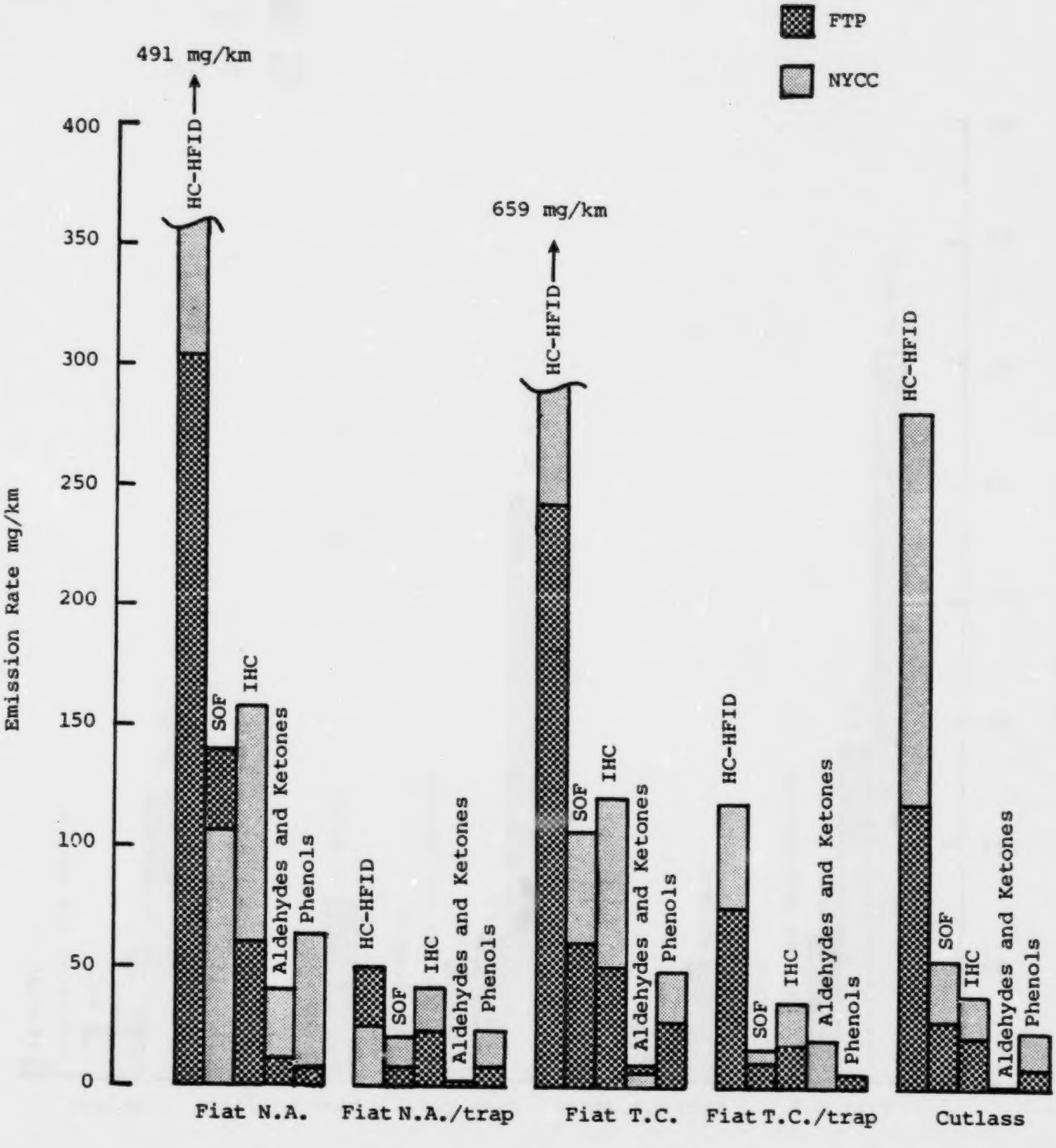


Figure 3. FTP and NYCC organic emissions of Fiat N.A., Fiat T.C., and 1981 Oldsmobile Cutlass diesel vehicles with EM-329-F fuel.

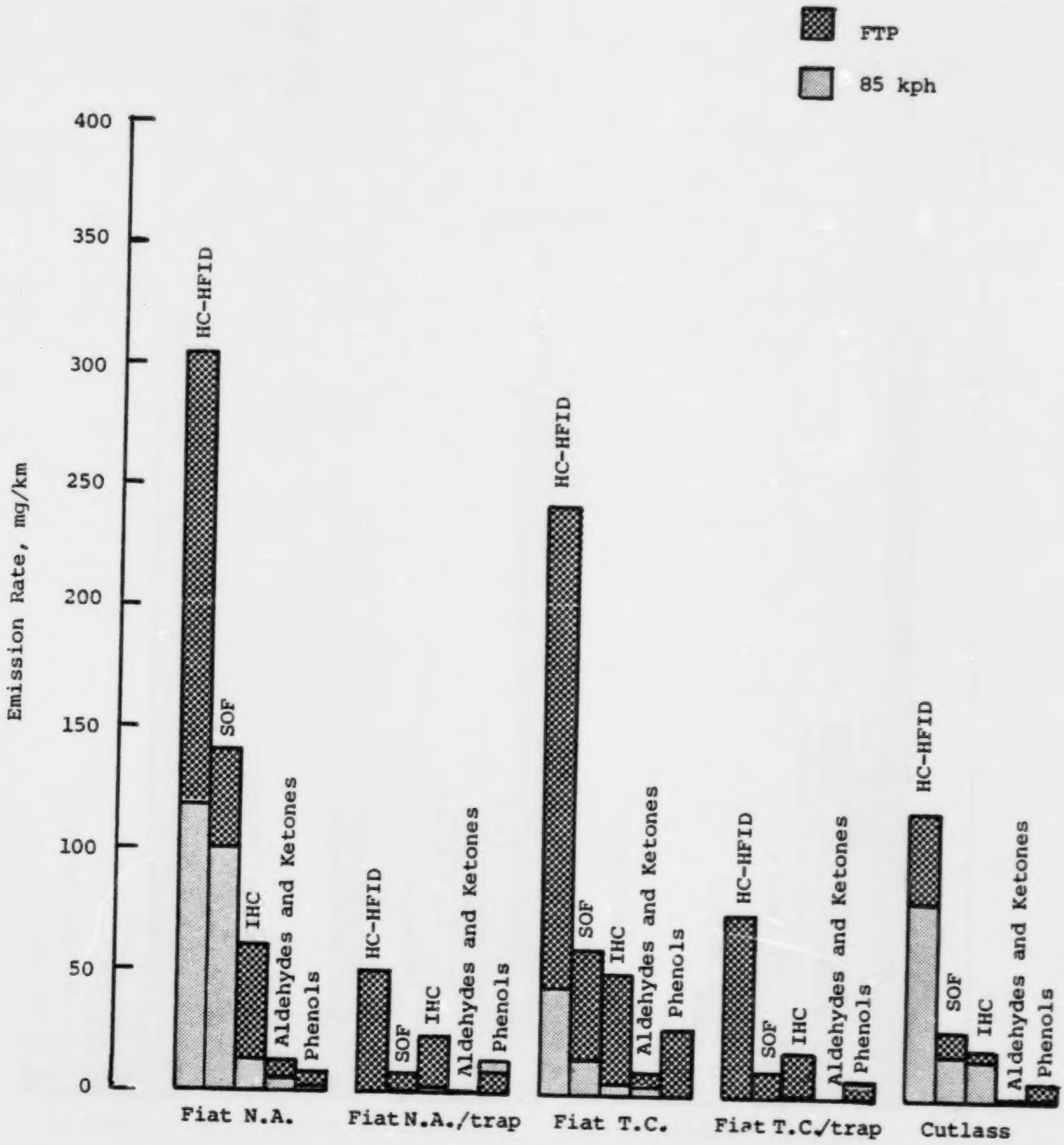


Figure 4. FTP and 85 kph organic emissions of Fiat N.A., Fiat T.C., and 1981 Oldsmobile Cutlass diesel vehicles with EM-329-F fuel.

varied with fuel and vehicle; while Figures 2 through 4 provide a comparison of emissions between the FTP and the other cycles used with each vehicle for fuel EM-329-F only. The total HC emissions are from the 3-bag FTP, and the emissions of the remaining four pollutants are from the 4-bag FTP (0.43 times 23-minute cold FTP plus 0.57 times 23-minute hot FTP).

The FTP emissions shown in Figure 1 were generally higher with EM-469-F than with EM-329-F, but not by substantial amounts. The highest emissions of HC, SOF, IHC, and aldehydes and ketones were from the Fiats without aftertreatment. The SOF was the largest portion of the total HC obtained using the Fiats without aftertreatment, ranging from 25 to 46 percent of the total HC. Catalytic trap use on the two Fiats significantly reduced emissions of total HC, SOF, IHC, and aldehydes. Total hydrocarbons alone were reduced by an average of 83 percent on the naturally-aspirated Fiat, and by an average of 64 percent on the turbocharged Fiat. Average reductions of SOF with catalytic traps were 96 and 88 percent for the Fiat N.A. and T.C. diesels, respectively.

All vehicle emissions shown in Figure 2, except for the phenols of the Fiat T.C./trap configuration, were lower on the HFET than on the FTP. The HFET total HC was less than 50 percent of the FTP total HC on all the Fiat vehicle configurations. The highest fraction of the HFET total HC on the Fiats without aftertreatment was SOF, emitted at an average of 55 percent of the total HC emission rate. The HFET SOF emission rate of the trap-equipped Fiats, was 21 percent (average) of the HFET total HC emission rate. The HFET total hydrocarbon and SOF reductions with trap use on the naturally-aspirated Fiat amounted to 91 and 97 percent, respectively. Corresponding HFET total hydrocarbon and SOF emissions reductions with trap on the turbocharged Fiat were 73 and 84 percent.

The majority of vehicle emissions shown in Figure 3 were higher on the NYCC than on the FTP, especially total hydrocarbons from the Fiats without aftertreatment and the Cutlass. Highest total hydrocarbons, SOF, and IHC in the NYCC evaluations were emitted by the Fiats without aftertreatment. The SOF emission rates on the NYCC were 22 and 16 percent of the total hydrocarbon emission rates on the Fiat N.A. and T.C. diesels without aftertreatment, respectively. Significant reductions in NYCC total hydrocarbon and SOF emissions occurred with trap use on the Fiats - total hydrocarbons were reduced by 95 percent (Fiat N.A.) and 82 percent (Fiat T.C.), while SOF was reduced by 81 percent (Fiat N.A.) and 85 percent (Fiat T.C.).

Total hydrocarbon, SOF, IHC, and aldehyde emissions from each vehicle were all lower on the 85 kph than on the FTP as shown in Figure 4, most clearly with the trap-equipped Fiats. The SOF emission rates were 84 and 33 percent of the total hydrocarbons emitted at 85 kph using the Fiat N.A. and T.C. vehicles without aftertreatment, respectively. Total 85 kph hydrocarbon and SOF reductions with trap use on the Fiats were greater than 96 percent.

Other important observations and conclusions reached as a result of this project (not necessarily in order) are as follows:

- Catalytic trap use on the naturally-aspirated and turbocharged Fiats provided acceptable engine operation on all cycles and with each test fuel. Over its 1686 km (1048 mi) of use, the catalytic trap on the naturally-aspirated Fiat required regeneration every 422 km (261 mi) on the average, while the trap on the turbocharged Fiat required no regeneration over the entire 1141 km (877 mi) of its use.

- Emissions of CO by the Fiat N.A. and T.C. vehicles were reduced by an average of 91 percent on the Fiat N.A. diesel and 80 percent on the Fiat T.C. diesel when the catalytic traps were used.
- With trap use and both fuels, the NO_x emissions of the naturally-aspirated Fiat were increased by an average of 17 percent. Trap operation on the turbocharged Fiat reduced NO_x emissions slightly with EM-329-F and increased them slightly with EM-469-F. The effect of trap backpressure on the NO_x emission changes observed is not known, since trap backpressure was not monitored continuously during emissions testing performed on the Fiats.
- Regulated particulate emissions of the Fiats were lower for every cycle and fuel combination with catalytic trap than without, by an average of 65 and 55 percent on the Fiat N.A. and T.C. diesels, respectively. No major differences in particulate emissions with respect to fuel type were generally found by vehicle or driving cycle.

- Highest fuel economy overall was obtained with the two naturally-aspirated Fiat configurations, and lowest economy overall with the Cutlass. With each test vehicle and fuel, fuel economy was highest in the HFET and 85 kph, as expected. No obvious trends were noted for fuel economy between fuels in most of the vehicle configurations. Although fuel economy decreased somewhat with trap use on the Fiat N.A. diesel in the HFET and 85 kph with EM-329-F, no substantial change in fuel economy was evident between the two different exhaust configurations of the turbocharged Fiat.
- Methylene chloride soluble organics were significantly lower with the catalytic traps on the Fiat N.A. and T.C. diesels than without. Over the five cycles and two fuels, the average percent by weight of solubles decreased from 58 percent with no aftertreatment to 9 percent with trap for the naturally-aspirated Fiat, and from 34 percent with no aftertreatment to 10 percent with trap for the turbocharged Fiat.
- Weak to strong positive mutagenic responses were obtained on all organic solubles from particulate emitted by the five vehicle configurations and two fuels. Highest overall mutagenic response in revertants/μg was obtained with the trap-equipped Fiats. On the basis of revertants/km, however, the trap-equipped Fiats generally indicated the lowest mutagenic activity. Revertants/km of the Fiats with traps were reduced by an average of 73 percent on the naturally-aspirated Fiat and by an average of 66 percent on the turbocharged Fiat as compared to corresponding cases without aftertreatment.

- Benzo(a)pyrene emission rates ranged from "non-detected" to 30.8 µg/km, with most BaP emission rates less than 7.8 µg/km. Highest BaP emissions on each cycle and with each fuel were associated with the two Fiats without aftertreatment. Employing the catalytic trap on the Fiats, however, generally reduced their BaP emissions by more than 82 percent on the naturally-aspirated Fiat, and by more than 53 percent on the turbocharged Fiat.
- Fractionation of organic solubles by HPLC determined that their normalized relative response was generally lowest in the transitional region and highest in the polar region. Correlation between the normalized peak area and the results of Ames and BaP was not discerned.
- Ethylene usually accounted for at least half of the "total" IHC for each vehicle, cycle, and fuel combination. The average reductions of "total" IHC emissions with catalytic trap was 70 percent on the Fiat N.A. diesel and 48 percent on the Fiat T.C. diesel.
- Aldehyde emissions showed overall low concentrations and considerable scatter. Formaldehyde was generally the largest portion of the "total" aldehydes evaluated, and at times was the only aldehyde detected. Highest formaldehyde emissions were those from the Fiats without aftertreatment. With trap use, formaldehyde was reduced by more than 53 percent on the naturally-aspirated Fiat and by more than 43 percent on the turbocharged Fiat. The FTP formaldehyde emissions of the trap-equipped Fiats were low (from

"none detected" to 2.4 mg/km), and comparable to those obtained in a separate EPA study using low mileage 1978 oxidation catalyst-equipped gasoline cars.

- Ammonia emission rates ranged from 0.43 to 118 mg/km, with most emissions measuring under 10 mg/km. The cold FTP and hot FTP ammonia emissions were reduced using the trap catalyst on the Fiat N.A. diesel.

- The phenol compound appearing most consistently and found in largest quantities throughout the study was 2,3,5,6-tetramethyphenol. Although "total" phenol emissions indicated considerable variation overall, the results did indicate some reduction of phenols with the trap-equipped Fiats.
- Most total cyanide emissions were above the minimum detectable limit (MDV) by at least a factor of three. Catalytic traps on the Fiats were usually associated with slightly higher total cyanide emissions.
- Analysis of "trap-collected" gaseous hydrocarbons showed a strong tendency towards lower temperatures of boiling range and light ends than found with the fuels themselves. The Fiat N.A. diesel with catalytic trap consistently indicated lower HC boiling ranges with EM-469-F than with EM-329-F. The light-end boiling temperatures of the Fiat T.C. diesel were consistently lowered with use of the catalytic trap.
- Carbonyl sulfide and methyl sulfide were always present in exhaust with all vehicle configurations, fuels, and test cycles at emission rates ranging from 1.5 to 206 mg/km, and from 0.15 to 43 mg/km, respectively. No strong emissions trends of "total" sulfides with fuels on most vehicles, or with trap use on the Fiats were apparent.
- Hydrogen sulfide was not detected in dilute exhaust of any vehicle evaluated during the 4-bag FTP (~0.34 mg/km MDV), HFET (0.24 mg/km MDV), or NYCC (2.16 mg/km MDV).

- Organic amines, when detected, were generally found at low concentrations. An indication of increased organic amines emissions was apparent on the Fiat T.C. diesel with trap use.
- No N-nitrosamines were detected in dilute exhaust of any test vehicle tested over an entire test sequence consisting of a 4-bag FTP, HFET, NYCC, and 85 kph steady-state. The average MDV for nitrosamines ranged from 0.90 μg/km to 4.4 μg/km depending on the analytical procedure used.
- Strong fuel trends did not emerge in the visible smoke emitted from the test vehicles. The use of catalytic traps on both Fiats generally reduced their visible smoke. Overall, the lowest and highest smoke emitters were the Fiat N.A. with catalytic trap and the Fiat T.C. without aftertreatment, respectively.
- Particles aerodynamically-sized by an inertial impactor indicated that catalytic trap use generally increased particle size on the Fiat N.A. diesel with both fuels, and on the Fiat T.C. diesel with EM-469-F. The Fiat N.A. diesel with trap emitted the largest particles overall, with about 60 percent of its particles measuring more than 0.1 micron ECD (Effective Cutoff Diameter).
- Low hydrogen content, indicative of dry or soot-like particulate material rather than an oily material, was found in most particulate matter by elemental analysis. Significant elemental content differences between fuels were not apparent. Carbon content for the trap-equipped Fiats was decreased in the HFET and 85 kph. Nitrogen in particulate matter averaged 0.5 percent overall.

- Sulfate emissions with the trap and fuel EM-329-F were increased in the HFET, NYCC, and 85 kph using the Fiat N.A. diesel, but were decreased in all cycles using the Fiat T.C. diesel with trap. The largest increase in sulfate, as percent of particulate, occurred on the HFET and NYCC with the Fiat N.A. diesel using the trap.
- Trace elements most commonly found in particulate matter from the test vehicles were sulfur, magnesium, aluminum, zinc, silicon, calcium, iron, barium, and phosphorus. Sulfur and iron generally accounted for more than fifty percent of the "total" trace element emission rate in each cycle. Overall, the elements emitted made up from 1.2 to 11.8 percent of the particulate emission rate. Trace element emission rates greater than 3 percent of the particulate emission rate were emitted only by the trap-equipped Fiats.
- Analysis for carbon, hydrogen, and nitrogen in organic solubles indicated the presence of hydrocarbon-like materials with numeric H/C ratio between 1.58 and 1.95. The catalytic trap-equipped Fiats were associated with the lowest H/C ratio for the 4-bag FTP, which may indicate that a higher content of unsaturated hydrocarbons was present with trap than without trap.
- Determination of organic solubles boiling range was significantly limited by what appeared to be sample polymerization or actual degradation of sample during G.C. analysis. Resultant boiling range data more successfully interpreted indicated no major or consistent differences of solubles boiling range with fuel type. Both Fiat T.C. diesel configurations and the Cutlass indicated an overall upward shift in solubles boiling range as compared to fuel boiling ranges.

III. VEHICLES, FUELS, AND TEST PROCEDURES

This section describes the vehicles, fuels, test procedures and test plan used in this project. The facilities, general instrumentation, and overall sampling system for unregulated emissions are also discussed.

A. Test Vehicles

Examples of engine types initially considered for testing included gas turbines, Stirling cycle, turbocharged and naturally-aspirated diesel, Rankine cycle, stratified charge, and advanced Otto-cycle. Actual vehicle availability during the program permitted only three diesel-powered automobiles to be evaluated in this project. The automobiles included a prototype naturally-aspirated Fiat, a prototype turbocharged Fiat, and a regular production 1981 Oldsmobile Cutlass coupe as described in Table 1. The Fiat diesels were obtained from the Department of Energy (DOE), Bartlesville Energy Technology Center, Bartlesville, Oklahoma, after various emissions studies(4) with the two cars were completed there. A local search for a rental 1981 Oldsmobile Delta 88 diesel car was not successful, so with the Project Officer's approval, an available 1981 Oldsmobile Cutlass coupe with less than 4827 km (3000 mi) was rented. The Oldsmobile was equipped with optional equipment consisting of automatic transmission, air conditioning, power steering, and power brakes. Standard rear axle ratio and tires were provided on the Cutlass. Respective rear axle ratios and tire sizes for the Fiats are listed in Table 1. Views of the three diesel test vehicles as evaluated on the dynamometer are shown in Figure 5.

TABLE 1. DESCRIPTION OF DIESEL TEST VEHICLES

Vehicle Model	Fiat 131 Naturally-Aspirated	Fiat 131 Turbocharged	Oldsmobile Cutlass Supreme
Model Year	Prototype	Prototype	1981
Vehicle Identification No.	131AZ4275399	131AZ4280788	1G3AM47N5BR481685
Engine Model No.	8140.61	8140.81	--
Chassis Dynamometer Setting:[a]			
Inertia, kg (lbs)	1361 (3000)	1361 (3000)	1814 (4000)
Power, kW (hp)	8.2 (11.0)	8.2 (11.0)	8.6 (11.5)
Engine Displacement ℓ(in^3)	2.4 (146)	2.4 (146)	5.7 (350)
Turbocharger	No	Yes	No
Cylinders	In-Line 4	In-Line 4	V-8
Combustion Chamber	Prechamber	Prechamber	Prechamber
Compression Ratio	22	22	22.5
Injection System	Bosch	Bosch	Roosa Master
Maximum Power kW (hp)	52.2 (70) @ 4200 rpm	63.4 (85) @ 4000 rpm	78.3 (105) @ 3200 rpm
EGR	No	No	Yes
Catalytic Trap	No[b]	No[b]	No
Transmission	5-speed manual	5-speed manual	3-speed automatic
Axle Ratio	3.2	3.6	standard
Tire Type	steel-belted radial	steel-belted radial	steel-belted radial
Tire Size	165SR13	165SR13	P195/75R14
Initial Distance on vehicle, km (mi)	9879 (6140)	7659 (4760)	4233 (2631)
Final Distance on vehicle, km (mi)	12501 (7769)	9764 (6068)	5081 (3158)

[a] Chassis dyanmometer settings selected on basis of settings used by the Department of Energy at Bartlesville, Oklahoma for the Fiats and by the EPA for certification of 1981 Oldsmobile Cutlass.

[b] Each Fiat was initially studied without exhaust aftertreatment, but was also tested with a catalytic trap-oxidizer provided by Johnson-Matthey.

Prototype Fiat Naturally-Aspirated Diesel

Prototype Fiat Turbocharged Diesel

1981 Oldsmobile Cutlass Diesel

Figure 5. Views of diesel vehicles as evaluated on dynamometer

Preparation of each test vehicle upon arrival at SwRI included draining of its fuel tank and fuel filter, and refilling them with the baseline fuel used in the program. The crankcase oil was also changed to new Quaker State SAE 30 SE/CC grade oil, and the oil filter was replaced with a new filter. Before actual testing was begun on each car, it was conditioned on the dynamometer at alternating speeds of 48, 64, and 80 kph for approximately 80 km.

The Fiats were initially studied without exhaust aftertreatment, and subsequently with catalytic trap-oxidizers. Installation of traps on the Fiats and their evaluations are described in Section V of this report. Apart from the traps used on the Fiats, no other modification to the exhaust systems or engines was performed on the three test vehicles. The injector pump timings on the Fiats were left as last used at DOE; one degree BTC on the naturally-aspirated Fiat, and three degrees after TDC on the turbocharged Fiat at the manufacturer's specified pump lift. At the Project Officer's request, the injector timing on each Fiat with and without exhaust aftertreatment was not altered so as to not cloud or bias the emission results between the two different exhaust configurations.

No significant operating difficulties were experienced with the three test vehicles during this project. Some initial periodic rough idling and stalling after cold start on the turbocharged Fiat was caused by a loose retaining nut on the throttle linkage, which in turn allowed excessive play in the idle adjustment. The trouble ceased when the retaining nut was retightened. Also on the same vehicle with catalytic trap, the engine abruptly lost power during the hot FTP cycle of the initial test sequence.

The difficulty was traced to a plugged fuel filter, and was subsequently corrected by replacing the filter with an identical filter purchased locally. A total of two fuel filter changes were made on the T. C. Fiat diesel during its study.

Of the three test vehicles, only the Oldsmobile Cutlass required more than the ordinary exhaust pipe adaptation to the dilution tunnel of the CVS sampling system. Since the Cutlass employed a dual exhaust system, a special exhaust extension tube to route the car exhaust to the dilution tunnel was manufactured. The exhaust tube consisted of a 99 cm (39 in) length of 5.1 cm (2 in) O.D. stainless tubing connected to each exhaust pipe on the car. The two lengths of 5.1 cm tubing were then welded in a y-arrangement to a single 7.6 cm (3 in) O.D. stainless tube, which in turn was connected to the dilution tunnel. The entire extension tube assembly was slightly less than 366 cm (12 ft) long and therefore did not require insulation.

B. Test Fuels

Several fuel options were initially presented to the Project Officer for use as test fuels in this project. For the primary fuel or base fuel, a "National Average" No. 2 material similar to those used for other EPA projects(5,6) and a 2D emissions test fuel were considered. Several SwRI fuels proposed for the second fuel of the study, either the same one for all vehicles, or different fuels based on some reasonable criterion, included the following:

SwRI Code No.	Fuel Type
EM-395-F	"H320" clean straight run No. 1
EM-401-F	JP-7 highly refined No. 1
EM-242-F	premium quality No. 2
EM-241-F	mimimum quality No. 2
EM-390-F	shale-derived No. 2

It was originally planned to use a "wide boiler" as the second fuel for this project, in all the vehicles which would burn it satisfactorily. Once it became apparent that all the vehicles needed a higher-cetane distillate to run well, however, other options were considered. If it were desired to look at a "best case" situation in addition to the No. 2 primary fuel, one of the first three materials listed above was deemed appropriate. The EM-241-F would provide a "worst case" comparison, and the results with EM-390-F fuel could not be reliably anticipated.

The two test fuels ultimately selected by the Project Officer for use in characterizing the advanced powerplants are described in Table 2. The fuel coded EM-329-F, was designated to be the primary or base fuel, and is a "National Average" No. 2 fuel supplied by this laboratory. The material was originally a Gulf No. 2 diesel whose sulfur content was adjusted to 0.24 weight percent by addition of ditertiary butyl disulfide. Twenty drums (55 gallons ea) of the Couch No. 2 fuel was received at SwRI from EPA-RTP in early 1979 for particulate accumulation on an Olds diesel (Contract 68-02-2703). The Olds program did not materialize, so in late 1980, 18 drums of the Couch fuel were shipped back to RTP. The remaining two drums were coded EM-469-F, and were retained for use as the "second fuel" in this project on recommendation of the Project Officer. The Couch fuel is basically a No. 2 home heating oil.

TABLE 2. PROPERTIES OF TEST FUELS

Fuel Code Description	EM-329-F	EM-469-F	
	"Nat'l. Avg." No. 2	Couch No. 2 Fuel	
		SwRI Analysis	EPA 6/80
Cetane Number	50.1		48.0
Cetane Index	52.1	48.1	48.1
Gravity, °API	37.5	35.2	35.2
Density, g/mℓ	0.837	0.849	0.849
Cloud point, °C (°F)	-8 (18)		
Flash point, °C (°F)	65 (149)		
Viscosity, cs	2.36		
Gum, mg/100 mℓ	14.3	12.9	
Total solids, mg/ℓ	7.4		
Metals in fuel, x-ray	0		
Carbon, %	85.8		84.60
Hydrogen, %	13.0		14.81
Nitrogen, ppm	48		<100[a]
Sulfur, %	0.24	0.18	0.30
Aromatics, %	21.3		39.1
Olefins, %	1.7		0.9
Saturates, %	77.0		60.0
D86, IBP	191 (377)	172 (342)	182 (360)
°C, 5% point	211 (412)	206 (402)	
(°F) 10% point	219 (427)	219 (426)	218 (424)
20% point	231 (448)	231 (448)	
40% point	251 (484)	252 (486)	
50% point		262 (504)	262 (504)
60% point	269 (517)	272 (522)	
80% point	290 (554)	297 (567)	
90% point	307 (585)	315 (599)	309 (588)
95% point	323 (613)	332 (629)	
EP	340 (644)	344 (651)	337 (638)

Some of the properties of the Couch No. 2 fuel remaining at SwRI (after the shipment of 18 drums to EPA-RTP) were measured or confirmed. These fuel analysis results are given in Table 2 along with data from EPA analyses of the Couch fuel supplied by Dr. Frank Black. The specifications of EM-469-F are quite consistent from laboratory to laboratory except for the sulfur levels, where the discrepancy may be in the methods used (SwRI used ASTM D-1266, "lamp" method).

On all emissions studies conducted during this project, each vehicle was fueled directly out of a 18.9 ℓ (5 gal) can through auxiliary fuel lines installed in the vehicle. At each fuel change, the vehicle fuel filter was removed and purged with the test fuel. Afterwards, the vehicle was conditioned on the dynamometer for 48 km (30 mi) at alternating speeds of 48 kph (30 mph), 64 kph (40 mph), and 80 kph (50 mph). At the start of the conditioning, the auxiliary fuel return line from the vehicle was removed from the test fuel can and directed to fill a separate waste-fuel 2000 mℓ container. Upon filling the container, the fuel return line was reconnected to the test fuel can to continue the conditioning and subsequent 23-minute FTP prep prior to testing. In this manner, an effective conditioning of the exhaust system and proper flush of the engine fuel filter and lines was assured each time a fuel was changed in a vehicle.

C. Test Procedures and Equipment

The regulated gaseous and particulate emissions tests conducted on the vehicles were performed following the appropriate Federal Regulations applicable to light-duty diesel vehicles(7) for 1981. Sampling and analyses of unregulated emissions were conducted according to procedures discussed in a subsequent section of this report.

1. Dynamometer and CVS Sampling System

A 50 hp Clayton ECE-50 passenger car dynamometer was used for all emissions testing on this project. The dynamometer has a direct-drive variable inertia system for simulation of vehicle mass from 454 kg (1000 lb) to 4082 kg (9000 lb) in 57 kg (125 lb) increments.

The constant volume sampler (CVS) used for these studies was Southwest Research Institute CVS Number 3. A 460 mm (18 in) diameter by 5 m (16 ft) long dilution tunnel was used in conjunction with the CVS, which operated at a nominal flowrate of 12.9 m^3/min (455 cfm). The dilution tunnel used is shown schematically in Figure 6. Additional dilution of 3.5 m^3/min (124 cfm) needed to maintain the tunnel sampling zone temperature below 125°F, as stipulated by the 1981 FTP(7), was provided by a 500x500 mm (20x20 in.) filter sampling system as identified in Figure 6. The large filter system is ordinarily used to obtain 500x500 mm Pallflex particulate filters for various gravimetric and chemical analyses. The large filter system is attached at the downstream end of dilution tunnel and consists of a positive-displacement blower with associated in-line 500x500 mm filter holder, temperature readouts and controls, and flow controls. The nominal flowrate (3.5 m^3/min) is held constant by temperature control using a heat exchanger and by maintaining constant pressure drop across the blower. All emission tests discussed in this report were run using the CVS and 500x 500 mm filter sampling system in combination to provide a total nominal flowrate of 16.4 m^3/min (579 cfm).

2. Regulated Gaseous Emissions

Regulated emissions were collected and analyzed using procedures

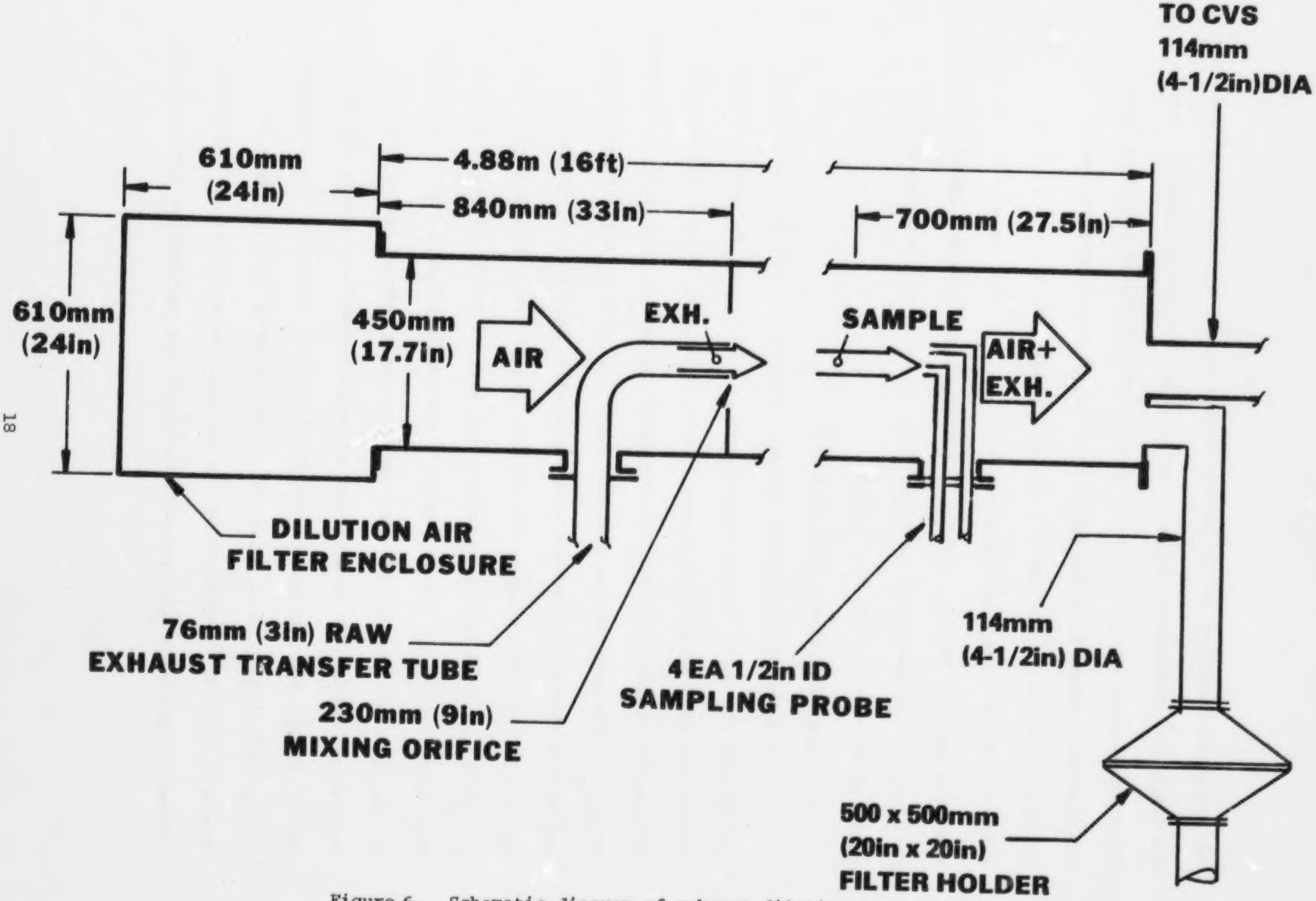
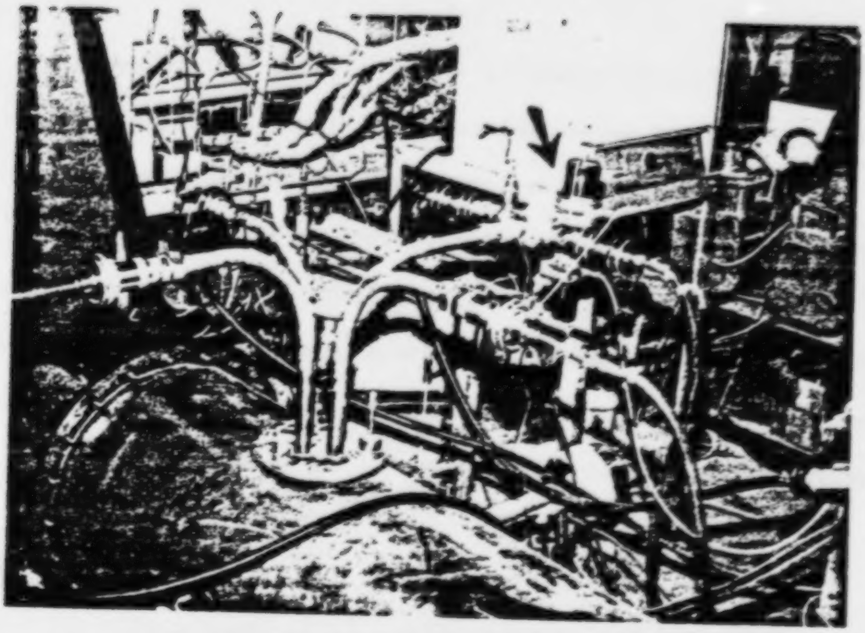

TO CVS
114mm
(4-1/2in)DIA
610mm
(24in)
4.88m (16ft)
840mm (33in)
700mm (27.5in)
610mm
(24in)
450mm
(17.7in)
AIR
EXH.
SAMPLE
AIR+
EXH.
DILUTION AIR
FILTER ENCLOSURE
76mm (3in) RAW
EXHAUST TRANSFER TUBE
230mm (9in)
MIXING ORIFICE
4 EA 1/2in ID
SAMPLING PROBE
114mm
(4-1/2in) DIA
500 x 500mm
(20in x 20in)
FILTER HOLDER

Figure 6. Schematic diagram of exhaust dilution tunnel

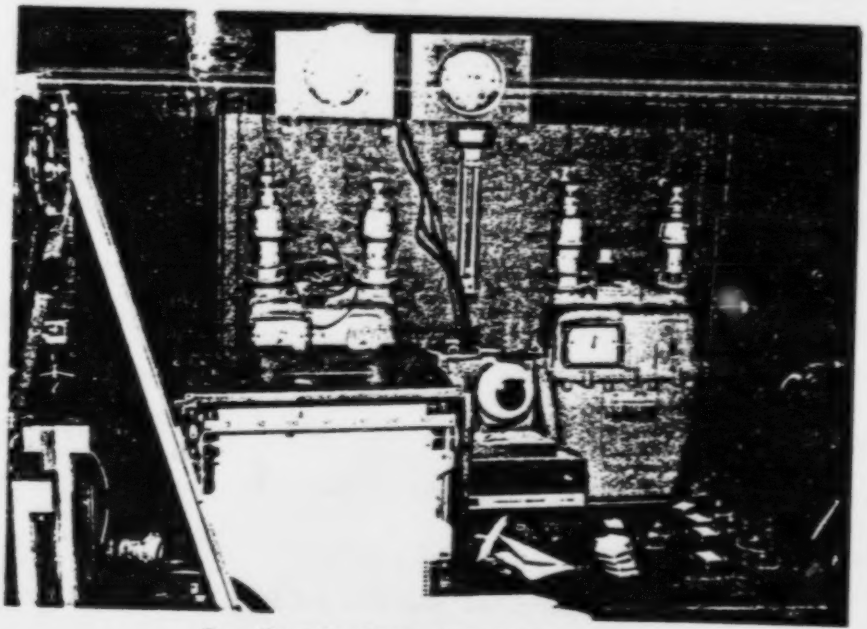
and equipment described in the Federal Register.(7) Hydrocarbon analysis of the sample was continuous, using a heated flame ionization detector (HFID). Electronic signal integration used with the HFID provided average dilute hydrocarbon concentration for each run. The gaseous sample was taken directly from the diluted exhaust stream through a heated probe in the dilution tunnel. The bagged gaseous emissions, as obtained at the CVS, were analyzed for CO, NO_x, and CO_2. Nondispersive infrared (NDIR) analyzers were used for determination of CO and CO_2, and a chemiluminescence (CL) analyzer was used for NO_x evaluation.

3. Regulated Particulate Emissions

A particulate sampling system, connected to the dilution tunnel and meeting the basic design requirements of the Federal Register(7), was used to simultaneously collect particulate on various 47 mm filter types. The sampling system employed the four sampling probes identified in Figure 6. Along with the usual filter holders, pumps, rotometers, temperature sensor, and dry gas meters, the system also employed an electro-pneumatically-controlled valve connected to one of the four probes. This solenoid valve enabled fast remote switching between two sets of paired primary test and back-up test filters. In this manner, the regulated particulate emissions in the different cycles of a test sequence, were sampled easily and separately, especially at the point of rapid transition between the cold or hot 505 and the subsequent stabilized phase of the FTP. The arrangement of the switching-solenoid valve and 47 mm filter holders is shown in Figure 7, View A. View B, shows the temperature recorder, dry gas meter, rotometer, and Magnehelic pressure gauges of the particulate sampling cart.



A. Switching solenoid valve with 47 mm filter holders



B. Particulate sampling cart

Figure 7. Views of regulated particulate sampling system

The commercially-available 47 mm Palllfex filters designated type T20A60, used in the determination of regulated particulate emission rates, are made of glass-fiber coated with fluorocarbon. The filters were weighed before and after use on a microbalance of one μg sensitivity. Before weighing, the filters were properly conditioned in a temperature- and humidity-controlled chamber which also housed the microbalance. The controlled airflow, temperature, and humidity provided an absolute humidity of 75±5 grains water per pound of dry air in the chamber.

4. Exhaust Sampling

Exhaust sampling was conducted employing the system shown schematically in Figure 8. The system was used in accordance with the guidelines established in various EPA projects conducted at SwRI. The major difference between this system and similar systems used in other projects is the number of sampling probes and systems required to collect the unregulated emissions samples. This complexity is illustrated in several views of the system as shown in Figure 9. View A of Figure 9 shows the overall sampling system with a test vehicle as run on the dynamometer. View B, Figure 9, shows the arrangement of various sampling carts near the dilution tunnel. In View C of Figure 9, some of the wet chemistry sampling carts, with impingers in place, are shown. The ThermoSorb/N trap used for sampling N-nitrosamines is shown connected to the outlet side of a 47 mm filter holder in View D of Figure 9.

This section had described the CVS and dilution tunnel system, and has provided some insight into the overall sampling system assembly. More details on each of the individual sampling systems for the unregulated

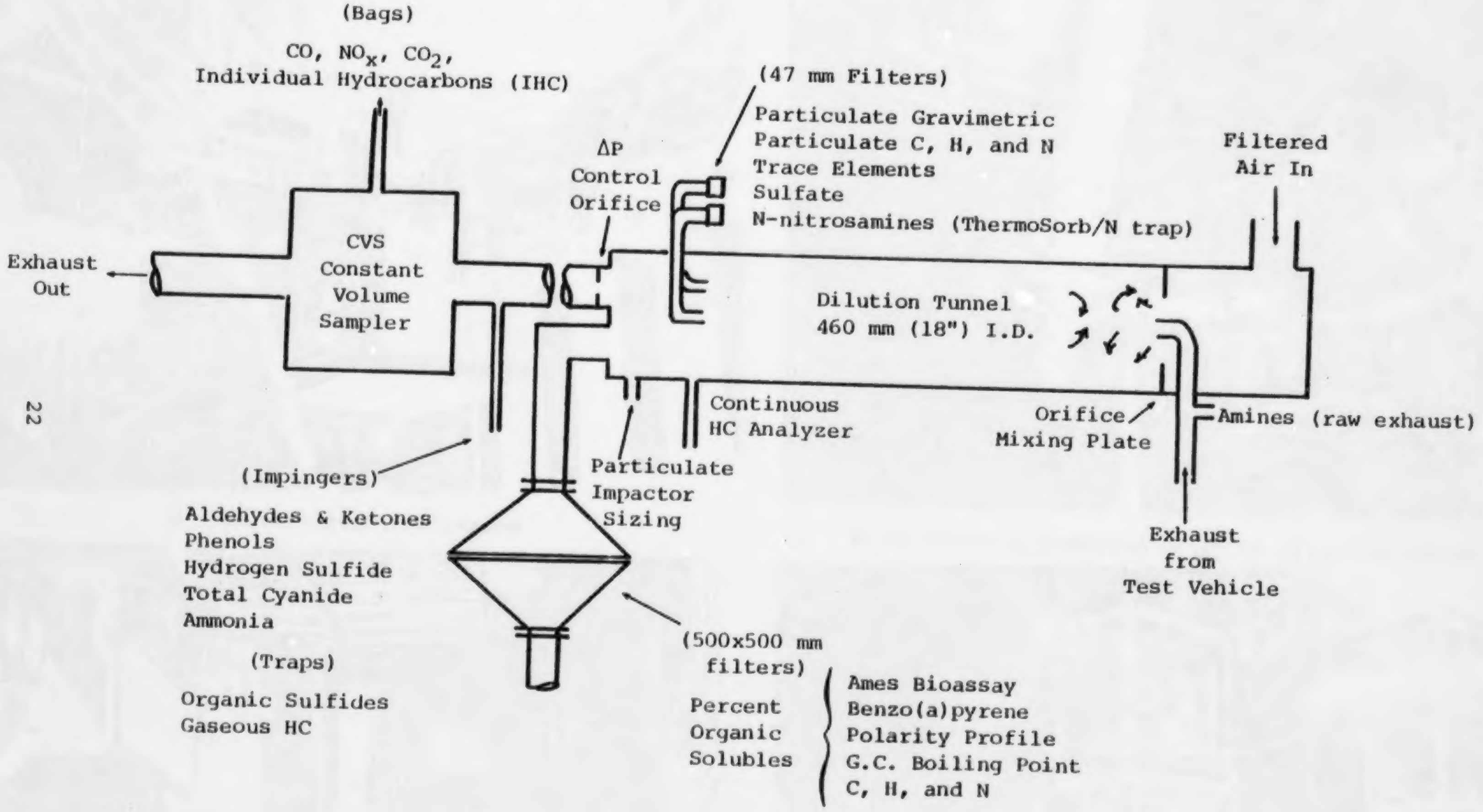
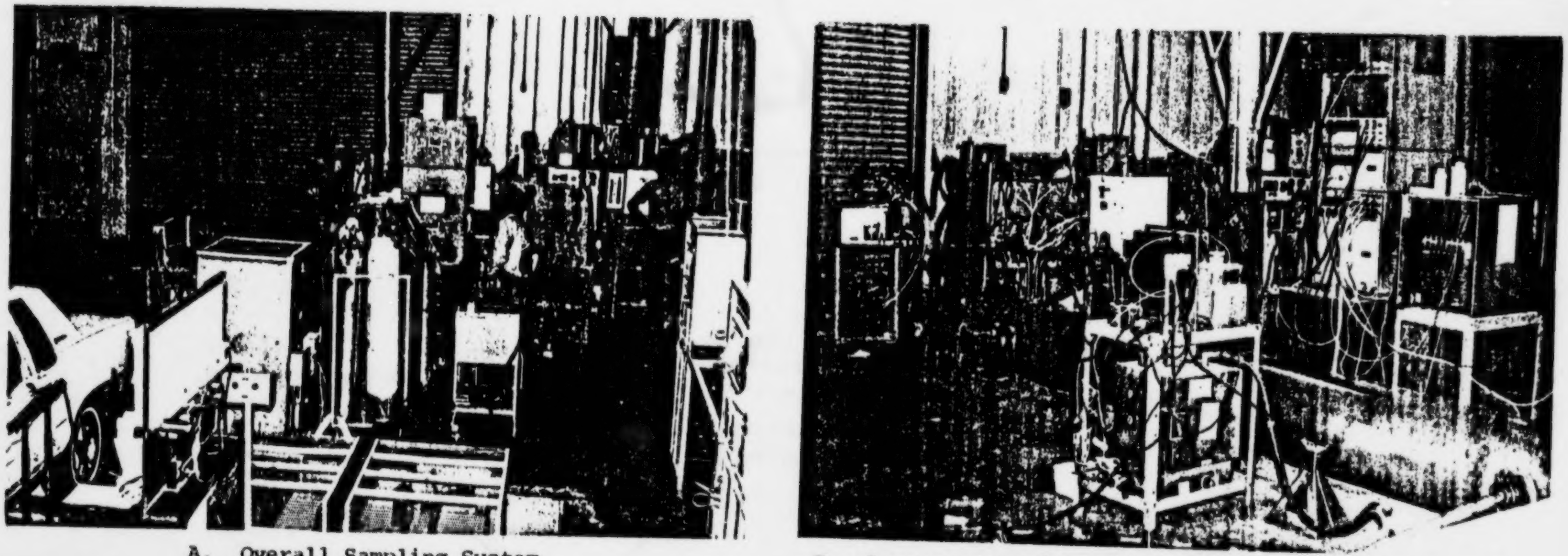
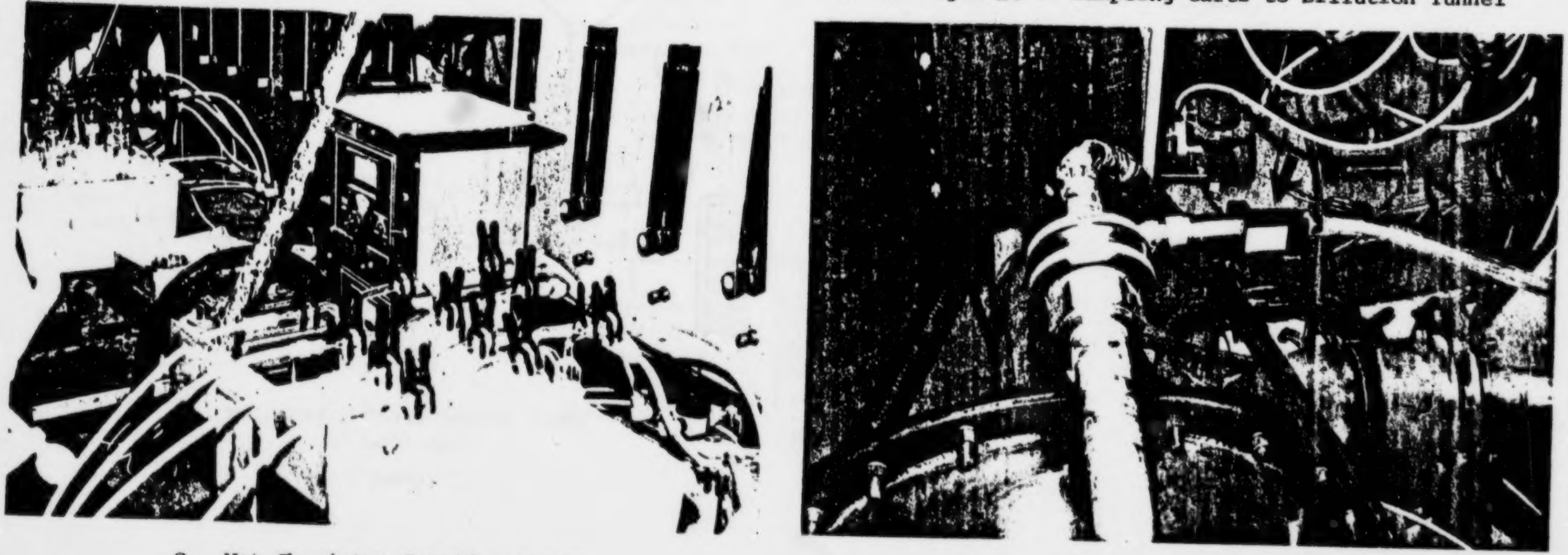

(Bags)
CO, NO$_x$, CO$_2$,
Individual Hydrocarbons (IHC)
(47 mm Filters)
Particulate Gravimetric
Particulate C, H, and N
Trace Elements
Sulfate
N-nitrosamines (ThermoSorb/N trap)
Filtered
Air In
ΔP
Control
Orifice
Exhaust
Out
CVS
Constant
Volume
Sampler
Dilution Tunnel
460 mm (18") I.D.
Continuous
HC Analyzer
Orifice
Mixing Plate
Amines (raw exhaust)
(Impingers)
Particulate
Impactor
Sizing
Aldehydes & Ketones
Phenols
Hydrogen Sulfide
Total Cyanide
Ammonia
Exhaust
from
Test Vehicle
(500x500 mm
filters)
(Traps)
Organic Sulfides
Gaseous HC
Percent
Organic
Solubles
Ames Bioassay
Benzo(a)pyrene
Polarity Profile
G.C. Boiling Point
C, H, and N

Figure 8. Emissions sampling system



A. Overall Sampling System

B. Arrangement of Sampling Carts to Dilution Tunnel



C. Wet Chemistry Sampling Carts

D. ThermoSorb/N Trap for N-nitrosamines

Figure 9. Views of the emissions sampling system

emissions are given in Section IV of this final report.

5. Emissions Test Procedures

The emissions test procedures utilized in this project are defined as follows:

FTP - 1981 Federal Test Procedure(1) (uses the Urban Dynamometer Driving Schedule).

HFET - Highway Fuel Economy Driving Schedule.(2)

NYCC - New York City Cycle.(3)

85 kph Cruise - 85 kph Steady-State (the test cycle is of 20 minutes duration, and begins immediately after stable 85 kph speed is reached).

The HFET and NYCC are hot-start, single-segment driving cycles. The FTP, however, involves cold-start and hot-start, multi-cycle with multi-segment operation. The FTP, HFET, and NYCC schedules are illustrated in Figure 10. A summary of the driving schedule parameters is presented in Table 3. In addition, in this project, a four-bag FTP was utilized for

TABLE 3. SUMMARY OF DRIVING SCHEDULE PARAMETERS

Driving Schedule	Duration, Seconds	Distance, Kilometers	Average Speed	
			km/hr	mph
FTP:				
505	505	5.8	41.3	25.7
867	867	6.2	25.8	16.2
UDDS	1372	12.0	31.4	19.5
HFET	765	16.5	77.6	48.2
NYCC	599	1.91	11.5	7.1
85 kph	1200	28.3	85.0	52.8

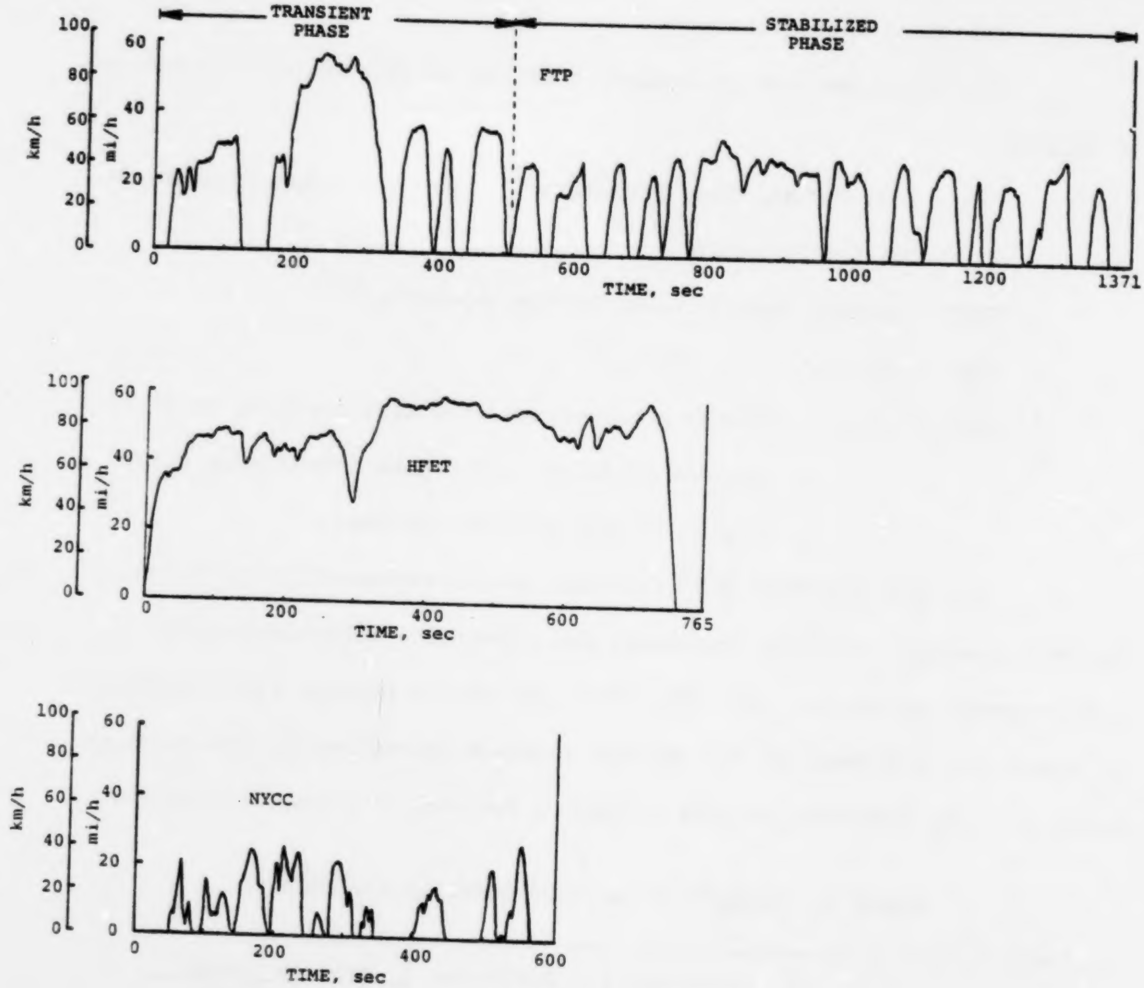


Figure 10. FTP, HFET and NYCC driving cycles vs time traces

the unregulated emissions; rather than the three-bag FTP specified in the Federal Test Procedure. Therefore, before proceeding, it is important to clarify the meaning of FTP as used in this program:

> FTP - The FTP uses the Urban Dynamometer Driving Schedule (UDDS) which is 1372 seconds in duration. The UDDS, in turn, is divided into two segments; the first having 505 seconds and the second having 867 seconds. The FTP consists of a cold-start 505 and a stabilized 867, followed by a ten-minute soak and than a hot-start 505. In this project, the hot-start 505 was followed by another 867 segment. Sampling of the regulated and unregulated emissions during the 4-cycle or 4-bag FTP was as follows:

	Four-Cycle FTP			
	Cold UDDS		Hot UDDS	
Duration, seconds	505	867	505	867
Regulated Emissions, 3-bag	X[a]	X	X	X
Regulated Emissions, 4-bag	X	X	X	X
Unregulated Emissions:				
Individual Hydrocarbons	X	X	X	X
Impingers (except Amines)	---X----		----X---	
47 mm filters:				
sulfate	-----------X-----------			
C,H,&N	-----------X-----------			
trace elements	-----------X-----------			
500 x 500 mm filters	---X----		----X---	
N-nitrosamines (trap)[b]	-----------X-----------			
Gaseous Hydrocarbons (trap)	-----------X-----------			
Organic Sulfides (trap)	---X----		----X---	
Particulate Impactor Sizing	-----------X-----------			

[a] X designates an individual sample taken

[b] Same trap used for 4-bag FTP, HFET, NYCC, and 85 kph test sequences

A composite value in mass per distance for the three-cycle, three-sample FTP regulated emissions is calculated using the following formula:

$$\frac{\text{MASS}}{\text{DISTANCE}} = \frac{0.43 \times (\text{MASS } 1 + \text{MASS } 2) + 0.57 \times (\text{MASS } 3 + \text{MASS } 2)}{0.43 \times (\text{DIST. } 1 + \text{DIST. } 2) + 0.57 \times (\text{DIST. } 3 + \text{DIST. } 2)}$$

Assuming Distance 3 is equal to Distance 1, this equation can be reduced to:

$$\text{3-FTP } M/D \simeq \frac{0.43 \times (M1 + M2) + 0.57 \times (M3 + M2)}{D1 + D2}$$

For the four-cycle FTP, two sample, composite values determined in this project, the following formula was used:

$$\frac{\text{MASS}}{\text{DISTANCE}} = \frac{0.43 \times M(1 + 2) + 0.57 \times M(3 + 4)}{0.43 \times (D1 + D2) + 0.57 \times (D3 + D4)}$$

Assuming Distance 3 is equal to Distance 1 and Distance 4 is equal to Distance 2, then this equation can be reduced to:

$$\text{4-FTP } M/D \simeq \frac{0.43 \times M(1 + 2) + 0.57 \times M(3 + 4)}{D1 + D2}$$

Therefore, with the assumption that the changes in distance traveled are negligible, the composite results with the four-cycle FTP relative to results with the three-cycle FTP will differ only as the mass emissions emitted during Cycle 4 differ from that emitted during Cycle 2.

For single 4-bag FTP sampling obtained in this study, a composite value (not weighted) was obtained using the following formula:

$$\text{4-bag FTP Composite} = \frac{\text{Total Mass}}{\text{Total Distance Driven}}$$

6. Test Coding System

The test coding system generally used in this project is described in Table 4.

TABLE 4. TEST CODING SYSTEM

Order: VCFTSE*

Codes

V: Vehicle Number; 1 = Naturally-Aspirated Fiat, 2 = 1981 Oldsmobile Cutlass, 3 = Turbocharged Fiat

C: Vehicle Configuration; A = without exhaust aftertreatment, B = with catalytic trap-oxidizer

F: Fuel; 1 = EM-329-F, 2 = EM-469-F

T: Test Type; F = FTP, H - HFET, N = NYCC, S = 85 kph steady-state V = Cold 505 smoke test, R = Trap Regeneration

SE: Sequential Test No.

*Shorthand version initially used only with Fiat N.A. diesel and fuel EM-329-F was VC329T, where V = vehicle number, C = vehicle configuration, 329 - fuel EM-329-F, and T = test type.

D. Test Plan

The intent of the test plan was to evaluate as many emissions as possible during vehicle operation, allowing a significant amount of information to be collected with minimum repetitive testing. Consequently, in this project, five diesel vehicle (engine) configurations and two test fuels were run in the test plan. The vehicles employed in this study were earlier identified in Section III, A of this report and included a prototype naturally-aspirated Fiat with and without catalytic trap, a prototype turbocharged Fiat with and without catalytic trap, and a 1981 Oldsmobile Cutlass. The two fuels selected were coded EM-329-F and EM-469-F as discussed earlier.

The basic test sequences and emission measurements to be conducted on each vehicle configuration-fuel combination are summarized in Table 5. Not included in Table 5 were the various tests conducted to collect additional 500 x 500 particulate filters and to regenerate one of the catalytic traps used in this program as described under Section V., A of this report. Most emissions in Table 5 were sampled during a test sequence composed of a 4-bag FTP, HFET, NYCC, and 85 kph steady-state cycle. Soak periods consisted of ten minutes between cold and hot 23-minute FTP's, and generally twenty minutes after the 4-bag FTP and each of the subsequent test schedules. The twenty-minute soak periods permitted the many impinger and filter changes, as well as sampling equipment preparation required between the different test schedules. Individual sampling of regulated and unregulated emissions during the 4-bag FTP was carried out as described in Section III, C. 5. All emissions were obtained from CVS diluted exhaust, except for organic amines and visible smoke obtained from raw exhaust.

Although a reasonable effort was made to test each vehicle configuration and fuel per the test plan outlined in Table 5, some circumstances prevented complete adherence to it. Various repeat tests were run to replace erroneous data or to supply missing information. The previously-mentioned trap regeneration tests also required expansion of the project effort. In particular, many repeat tests that could not be fully anticipated in the test plan were run, to collect sufficient particulate sample amounts when these emissions were significantly reduced in the vehicle employing catalytic traps. Consequently, only some of the material- and labor-intensive analyses

TABLE 5. TEST SEQUENCES AND EMISSION MEASUREMENTS TO BE CONDUCTED ON EACH VEHICLE CONFIGURATION AND FUEL

Exhaust Constituents Measured or Characterized	Test Sequences									
	FTP, cold & hot			HFET		NYCC		85 kph		Cold
	1	2	3	1	2	1	2	1	2	505
Regulated gaseous, particulate, and fuel economy	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Unregulated gaseous										
individual hydrocarbons	✓	✓		✓		✓		✓		
aldehydes	✓	✓		✓	✓	✓	✓	✓	✓	
phenols	✓	✓		✓	✓	✓	✓	✓	✓	
hydrogen sulfide	✓			✓		✓				
total cyanide	✓									
ammonia	✓									
organic sulfides	✓	✓		✓	✓	✓	✓			
organic amines								✓		
nitrosamines	✓			✓		✓		✓		
hydrocarbons (trap)	✓					✓		✓		
Unregulated particulate										
mass	✓	✓	✓	✓	✓	✓	✓	✓	✓	
size distribution	✓									
trace elements	✓	✓		✓	✓	✓	✓	✓	✓	
CHN	✓	✓		✓	✓	✓	✓	✓	✓	
sulfate	✓			✓		✓		✓		
Particulate Organic Solubles (mass)	✓	✓	✓	✓	✓	✓	✓	✓	✓	
BaP	✓			✓		✓		✓		
boiling point	✓			✓		✓		✓		
CHN	✓			✓		✓		✓		
Ames	✓			✓		✓		✓		
polarity profile	✓			✓		✓		✓		
Visible Smoke, PHS meter										✓

deemed more significant were selected for implementation in order to remain within the effort allocated to the project. Even so, the total number of tests completed in the program was very extensive, requiring a total of 36 test sequences consisting of a 4-bag FTP, HFET, NYCC, and 85 kph cycle each. Other supplementary tests run were as follows:

Number of Tests Conducted	Test Type
10	4-bag FTP
30	hot 23-minute FTP
17	HFET
39	NYCC
25	85 kph
17	Cold 505
various	Trap Regeneration

The majority of the emissions samples generated in this project were analyzed in the Emissions Laboratory at SwRI. Other laboratories assisting in the analyses of the remaining samples are identified in a subsequent section (IV, A.) of this report. During the initial portion of the program, the Project Officer directed that extraction of the 500 x 500 mm filters and subsequent Ames and BaP analysis be conducted at this laboratory, rather than at EPA under the in-house measurements program as originally provided for in the contract. To accommodate the unexpected effort, careful changes were made to the test plan as reflected in the corresponding reduction of effort on the catalyst-equipped Fiat prototype cars. For the same reason, only screening tests for nitrosamines, total cyanide, amines, hydrogen sulfide, ammonia, and sulfate evaluations were included in the formally approved test plan of Table 5.

IV. ANALYTICAL PROCEDURES FOR UNREGULATED EMISSIONS

The analytical procedures used to measure the unregulated emissions are summarized in this section. A detailed description of the individual hydrocarbons, aldehydes, phenols, hydrogen sulfide, total cyanide, ammonia, organic sulfides, amines, and sulfate procedures along with a discussion of their development, validation and qualification is available in the Interim Report, "Analytical Procedures for Characterizing Unregulated Emissions from Vehicles Using Middle-Distillate Fuels."(8) The procedures were developed in our laboratory, during an earlier phase of this project.

A. Description of the Analytical Procedures

The unregulated emissions evaluated in this project, along with the methods of sampling and the procedures used in the analyses, are listed in Table 6. Individual hydrocarbons, aldehydes, phenols, organic sulfides, organic amines, N-nitrosamines, and trace elements are categories consisting of groups of compounds or elements. The corresponding procedures separate and identify a number of individual compounds within each of the groups. The analytical procedures involved in this project are described briefly as follows:

1. Individual Hydrocarbons

For measurement of the individual hydrocarbons, methane (CH_4), ethane (C_2H_6), ethylene (C_2H_4), acetylene (C_2H_2), propane (C_3H_8), propylene (C_3H_6), benzene (C_6H_6), and toluene (C_7H_8), a sample of CVS-diluted exhaust is collected in a Tedlar bag. This bagged sample is then analyzed for individual hydrocarbons using a gas chromatograph system containing four

TABLE 6. SAMPLING AND ANALYSIS METHODOLOGY FOR UNREGULATED EMISSIONS

Exhaust Emissions Sampled	Constituent(s) Analyzed	Sampling Method	Analysis Method
gases	individual hydrocarbons	sample bag (CVS)	injection, GC/FID
	aldehydes	impinger	DNPH, GC/FID
	phenols	impinger	extraction, GC/FID
	hydrogen sulfide	impinger	methylene blue derivative, spectrophotometer
	total cyanide	impinger	cyanogen chloride derivative, GC/ECD
	ammonia	impinger	ion chromatograph
	organic sulfides	trap	injection, GC/FPD
	organic amines	impinger	GC/NPD with ascarite pre-column
	N-nitrosamines	ThermoSorb/N trap	GC coupled to TEA analyzer*
	gaseous hydrocarbons	trap	extraction, GC/FID
particulate	size distribution	impactor-filter	gravimetric
	trace elements	filter, 47mm Fluoropore	x-ray fluorescence
	carbon, hydrogen, and nitrogen	filter, 47mm Glass	combustion/TC analyzer
	sulfate	filter, 47mm Fluoropore	barium chloranilate derivative (BCA), HPLC/UV
particulate organic solubles	organic solubles	500x500 mm filter	soxhlet extraction, gravimetric
	benzo(a)pyrene (BaP)	---	HPLC/fluorescence detection
	boiling point	---	GC/FID
	carbon and hydrogen	---	combustion/TC analyzer
	nitrogen	---	oxidation pyroplsis/chemiluminscence
	biological response	---	Ames bioassay
	polarity profile	---	HPLC/fluorescence and UV detection
smoke	smoke (visible)	optical	EPA smokemeter (continuous)

*If interferences occurred with GC/TEA analysis, a further analysis using HPLC/TEA was required.

separate columns, and a flame ionization detector. The peak areas are compared to an external calibration blend, and the individual hydrocarbon concentrations are obtained using a Hewlett-Packard 3354 computer system.

2. Aldehydes and Ketones

The collection of aldehydes (formaldehyde, acetaldehyde, isobutyraldehyde, hexanaldehyde, crotonaldehyde, and benzaldehyde) and ketones (acetone and methylethylketone) is accomplished by bubbling CVS diluted exhaust through glass impingers containing 2,4-dinitrophenylhydrazine (DNPH) in dilute hydrochloric acid. The aldehydes and ketones (also known as carbonyl compounds) react with the DNPH to form their respective phenylhydrazone derivatives. These derivatives are insoluble or only slightly soluble in the DNPH/HCl solution, and are removed by filtration followed by pentane extractions. The filtered precipitate and the pentane extracts are combined, and then the pentane is evaporated in a vacuum oven. The remaining dried extract contains the phenylhydrazone derivatives. The extract is dissolved in a quantitative volume of toluene, which contains a known amount of anthracene as an internal standard. A portion of this dissolved extract is injected into a gas chromatograph and analyzed using a flame ionization detector.

3. Phenols

The collection of phenols (phenol; salicylaldehyde; m-cresol/p-cresol; p-ethylphenol/2-isopropylphenol/2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol; 2,3,5-trimethylphenol; and 2,3,5,6-tetramethylphenol) is accomplished by bubbling CVS-diluted exhaust through two Greenburg-Smith impingers in series, each containing 200 mℓ of 1 N KOH chilled in an ice bath. The contents of each impinger are acifidied and extracted with ethyl ether. The samples are partially concentrated, combined, and then further concentrated to 1 mℓ. An internal standard is added, and the volume is adjusted to 2 mℓ. The final sample is analyzed with a gas chromatograph (GC) equipped with a flame ionization detector. Concentrations of individual phenols are determined by comparison to external and internal standards.

4. Hydrogen Sulfide

The collection of hydrogen sulfide is accomplished by bubbling CVS-diluted exhaust through glass impingers containing a buffered zinc acetate solution, which traps the sulfide ion as zinc sulfide. The absorbing solution is then treated with N,N-dimethyl-paraphenylene diamine sulfate and ferric ammonium sulfate. Cyclization occurs, forming the highly-colored heterocyclic compound methylene blue (3,9-bisdimethylaminophenazothionium sulfate). The resulting solution is analyzed with a spectrophotometer at 667 nm in a 1-cm or 4-cm pathlength cell, depending upon the concentration.

5. Total Cyanide (Hydrogen Cyanide plus Cyanogen)

The collection of total cyanide is accomplished by bubbling CVS-diluted exhaust through glass impingers containing a 1.0 N potassium hydroxide absorbing solution. This solution is maintained at ice bath temperature. An aliquot of the absorbing reagent is then treated with KH_2PO_4 and Chloramine-T. A portion of the resulting cyanogen chloride is injected into a gas chromatograph equipped with an electron capture detector (ECD). External CN^- standards are used to quantify the results.

6. Ammonia

The collection of ammonia is accomplished by bubbling CVS-diluted exhaust through impingers containing dilute sulfuric acid at ice bath temperature. A sample from the impinger is then analyzed for ammonium ion (NH_4^+) using an ion chromatograph, and the concentration in the exhaust is calculated by comparison to an ammonium sulfate standard solution.

7. Organic Sulfides

The collection of the organic sulfides, carbonyl sulfide (COS), methyl sulfide ($(CH_3)_2S$), ethyl sulfide ($(C_2H_5)_2S$), and methyl disulfide ($(CH_3)_2S_2$) is accomplished by passing CVS-diluted exhaust through Tenax GC traps at -76°C. At this temperature, the traps remove the organic sulfides from the dilute exhaust. The organic sulfides are thermally desorbed from the traps into a gas chromatograph sampling system, and injected into a gas chromatograph equipped with a flame photometric detector for analysis. External organic sulfide standards generated from permeation tubes are used to quantify the results.

8. Organic Amines

The collection of organic amines (monomethylamine, monoethylamine and dimethylamine, trimethylamine, diethylamine, and triethylamine) is accomplished by bubbling CVS-diluted exhaust through glass impingers containing dilute sulfuric acid. The amines are complexed by the acid to form stable sulfate salts, which remain in solution. A portion of this solution is then injected into a gas chromatograph equipped with an ascarite loaded precolumn and a nitrogen phosphorus detector (NPD). External amine standards in dilute sulfuric acid are used to quantify the results. On this project, the organic amines procedure was modified only as necessary to sample amines from raw exhaust instead of dilute exhaust.

9. N-nitrosamines

The collection of N-nitrosamines, N-nitrosodimethylamine (NDMA), N-nitrosodiethylamine (NDEA), N-nitrosodipropylamine (NDPA), N-nitrosodibutylamine (NDBA), N-nitrosopiperidine (NPIP), N-nitrosopyrrolidine (NPYR), and N-nitrosomorpholine (NMOR) is accomplished by passing CVS-diluted exhaust through a ThermoSorb/N trap designed by the Thermo Electron Corporation especially for trapping N-nitrosamines. The ThermoSorb/N trap air sampler cartridge has been reported in the literature to be free of artifact formation and capable of retaining 100 percent of preloaded nitrosamines.(9)

An 83 mm (3 1/4 in) length of 3.2 mm (1/8 in) I.D. x 6.4 mm (1/4 in) O.D. Teflon tube was fitted to the ThermoSorb/N trap inlet. The Teflon tube was then inserted into a thermocouple connector commonly joined to the exit side of a 47 mm filter holder containing a Pallflex filter. In this manner, only a small portion of the total exhaust flowing through the filter was diverted through the trap. The filter holder was attached to one of the four 47 mm filter sample probes used in conjunction with the dilution tunnel as described in Section III. C. 3., and as illustrated in Figure 3, View A of this report. An actual ThermoSorb/N trap as adapted to the filter holder was illustrated in View D of Figure 9. The outlet side of the ThermoSorb/N trap was connected to a pump, rotometer with flow control valve, and a dry gas meter to obtain the proper sampling rates of 2 ℓ/min.

For analysis, the sealed traps were sent to the Thermo Electron Corporation in Waltham, Massachusetts. Each trap was then eluted with 25:75 percent methanol:dichloromethane organic solvent to provie a 1.8 mℓ sample. For optimum sensitivity, the sample was primarily analyzed using a Hewlett-Packard HP5710A gas chromatograph coupled to a Model 543 TEA analyzer. If sample interferences were noted in GC-TEA analysis, the sample was further analyzed using an Alltech 110 HPLC coupled to a Model 502 TEA analyzer.

10. Gaseous Hydrocarbons

For use in boiling range analysis, gaseous hydrocarbons were collected from filtered, dilute exhaust using the sampling system of an earlier EPA Project.(5) A schematic of the sampling system which is also generally employed in diesel odor analysis (DOAS)(10) is shown in Figure 11. A multi-opening stainless steel probe directs the CVS-diluted exhaust to the oven, where it passes through a fiber glass filter, then into a metal bellows pump which directs the exhaust into a collection trap. The trap is a 51 mm (2 in) x 9.5 mm (3/8 in) O.D. stainless steel tube fitted with a connector on each end. Approximately one gram of Chromosorb 102 is packed into the trap and retained by stainless steel frits on each end. The dessicant removes moisture prior to the rotometer and dry gas meter. The flowrate employed in the system was 6 ℓ/min.

After use, the collection trap was eluted sufficiently with cyclohexane to obtain a 2 mℓ sample. Each eluted sample was submitted to the U. S. Army Fuels and Lubricants Research Laboratory of the Energy Systems Research Division at SwRI, and analyzed qualitatively by gas chromatograph for boiling range and for paraffin peaks. The chromatograph procedure was run according to ASTM D2887-73, which simulates distillation to 538°C (1000 °F) at atmospheric pressure. The equipment used for this

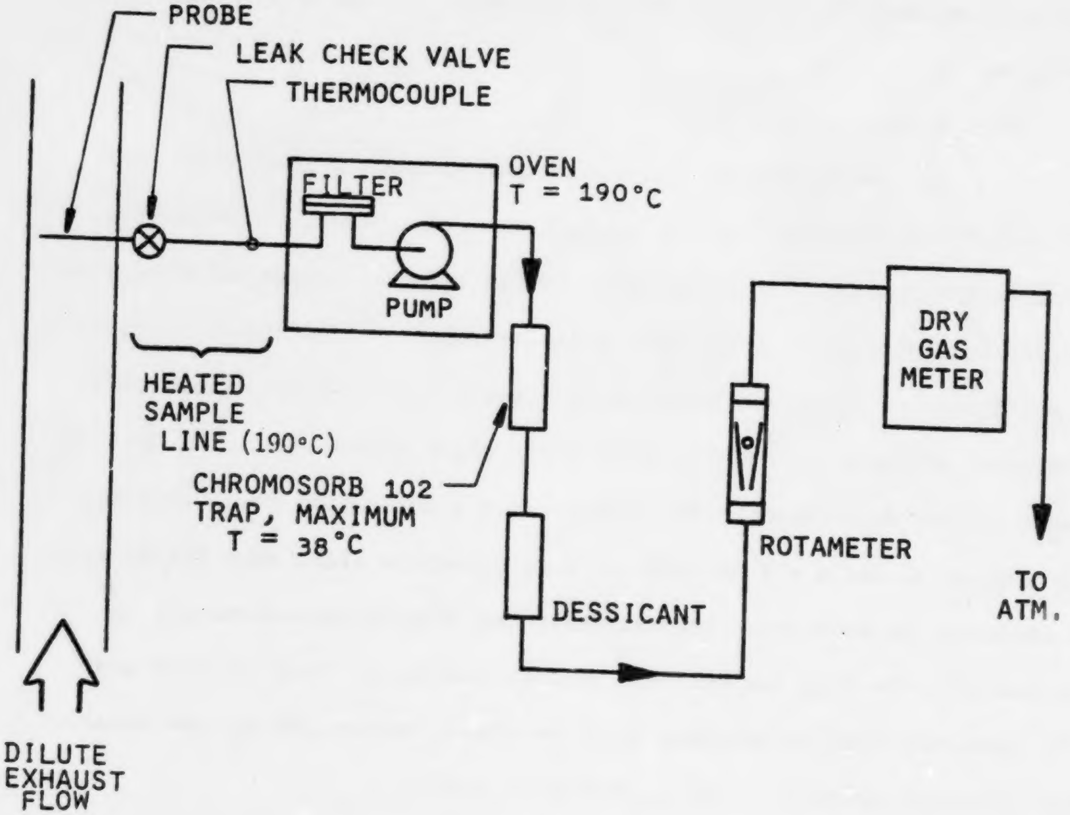

PROBE
LEAK CHECK VALVE
THERMOCOUPLE
FILTER
OVEN
T = 190°C
PUMP
HEATED
SAMPLE
LINE (190°C)
CHROMOSORB 102
TRAP, MAXIMUM
T = 38°C
DESSICANT
ROTAMETER
DRY
GAS
METER
TO
ATM.
DILUTE
EXHAUST
FLOW

Figure 11. Schematic diagram of gaseous HC sampling system (for boiling range analysis).

gas chromatograph analysis was a Hewlett-Packard 5700 Series unit, equipped with dual hydrogen flame ionization detectors. Its column was 1.8 m (6 ft) long by 3.2 mm (1/8 in) diameter stainless steel, packed with 5 percent SE-30 on 80/100 mesh Chromosorb-G. It was programmed from 0°C to 390°C at 16°C per minute. Data processing was performed on a Hewlett-Packard 3350 Laboratory Automated System.

11. Particle Sizing

Particle sizing was accomplished using a Sierra Series 220 radial-slot impactor. The impactor system contained stainless steel stages on which particulate matter was fractionated by size, and a final Pallflex backup filter. The impactor was located at the downstream end of the dilution tunnel. Figure 12 shows the impactor system protruding on the left side of the tunnel. Figure 13 shows the impactor system disassembled with the stages, plates, and filter removed from their holder for clarity. In operation, each stage was placed on a plate such that the slots in each stage decreased in width from sample entrance down to the filter. Each stage was rotated 45 degrees so the particulate matter passing through the slots impacted on a solid portion of the following stage. Particle retention characteristics were related to the slot size and flowrate through the impactor. The flowrate was controlled using a metal bellows vacuum pump, pressure guage, and flowmeter. The flowrate was selected to achieve a particle sizing range from 6.9 to 0.09 microns effective cut-off diameter (ECD). The fluorocarbon-coated glass fiber filter, used as a back-up filter, collected particulate smaller than 0.09 microns ECD. The mass of particulate matter collected on sample filters and impactor discs was determined using the microbalance housed in a controlled-humidity chamber, as described in Section III. C. 3.

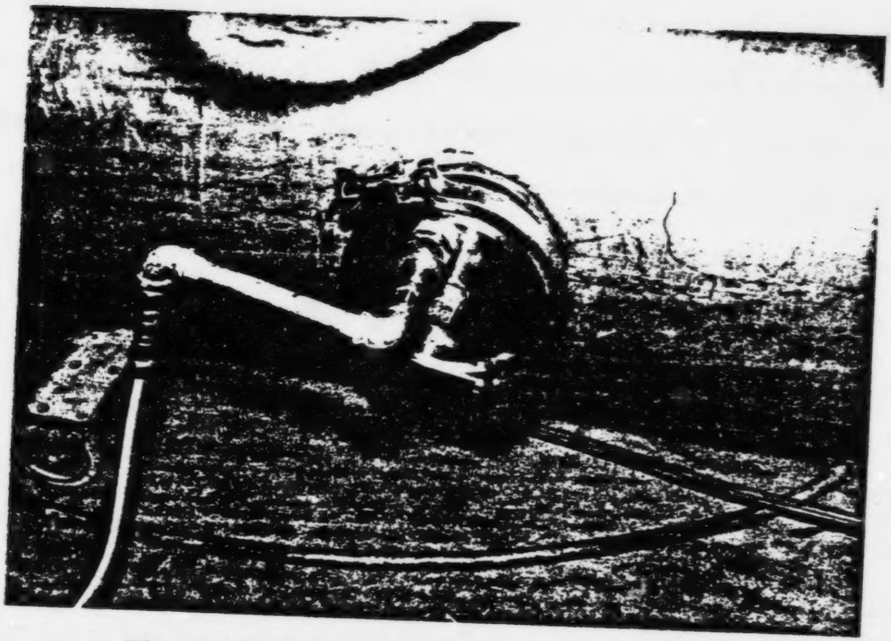


Figure 12. Installation of particle sizing impactor in dilution tunnel.

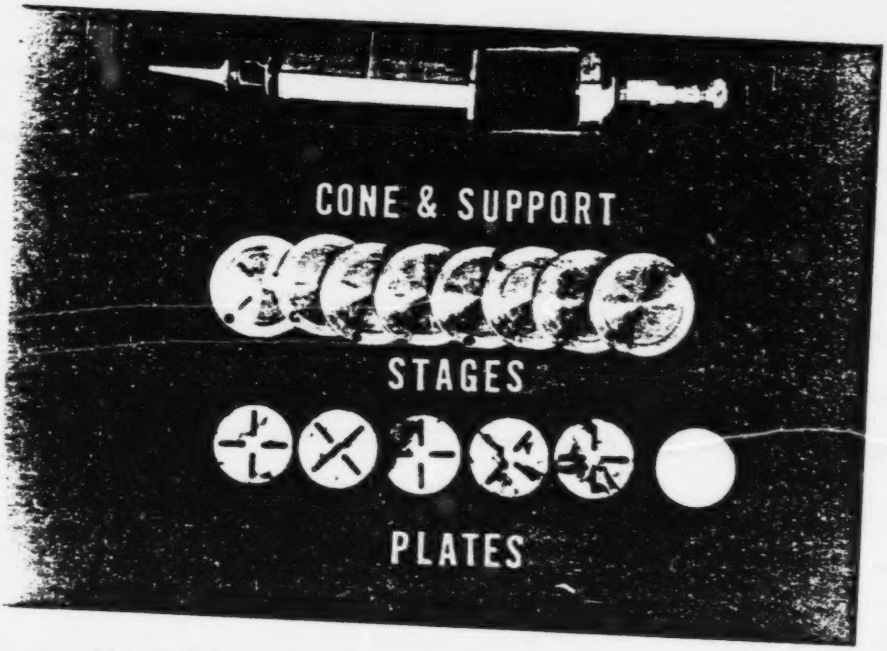

CONE & SUPPORT
STAGES
PLATES

Figure 13. Particle sizing impactor disassembled.

12. Trace Elements

The trace elements (metals and sulfur) were collected as part of the particulate on 47 mm Fluoropore filters. The CVS-diluted exhaust samples were taken from the dilution tunnel. Weight gain on the filter was determined by weighing the filter on a microbalance before and after sampling. The filter samples were sent to EPA-Research Triangle Park (RTP) for analyses by x-ray fluorescence, using a Siemens MRS-3 x-ray spectrometer.

13. Particulate, Carbon, Hydrogen, and Nitrogen

Particulate was collected on 47 mm Type A (Gelman) glass-fiber filter for the purpose of determining the carbon, hydrogen and nitrogen weight percentages. The CVS-diluted exhaust samples were obtained from the dilution tunnel. Weight gain on the filter was determined by weighing it on a microbalance before and after sampling. The required analysis on the particulate samples was performed by Galbraith Laboratories, using a Perkin-Elmer Model 240B automated thermal conductivity CHN analyzer. In order to accommodate the particulate sample on a filter, the filter had to be folded or rolled over itself. As the temperature was increased, the glass fiber media collapsed on itself, sometimes locking in some of the particulate. For this reason, significant inaccuracies can occur, but may be moderated by increased filter particulate loadings (Galbraith recommends at least 2 mg particulate loading on each filter to improve precision of analysis). To circumvent this difficulty, Spang Laboratories was initially considered for analysis of CHN in particulate. Spang required a particulate filter sample no larger than 15 mm in diameter.

Cutting or punching out the 15 mm filter discs from regular 47 mm filters introduced errors in the determination of particulate loading. These errors were believed to be as much or greater than those experienced with CHN analysis at Galbraith using 47 mm filters.

14. Sulfate

Automotive exhaust is routed into a dilution tunnel, where it is mixed with a flowing stream of filtered room air. In the tunnel, the SO_3 reacts rapidly with water in the exhaust to form sulfuric acid aerosols. The aerosols grow to a filterable size range within the tunnel, and are collected on a fluorocarbon membrane filter. Particulate sulfate salts are also collected on the filter.

Sulfuric acid collected on the filter is then converted to ammonium sulfate by exposure to ammonia vapor. The soluble sulfates are leached from the filter with a measured volume of an isopropyl alcohol - water solution (60% IPA). A fixed volume of the sample extract is injected into a high pressure liquid chromatograph (HPLC) and pumped through a column of strong cation exchange resin in Ag^+ form to scrub out the halides (Cl^-, Br^-), and then through a column of strong cation exchange resin in H^+ form to scrub out the cations and convert the sulfate to sulfuric acid. Passage through a reactor column of barium chloranilate crystals precipitates out barium sulfate, and releases the highly UV absorbing chloranilate ions. The amount of chloranilate ion released is proportional to the sulfate in the sample, and is measured by a sensitive liquid chromatograph UV detector at 310-313 nanometers. All the reactions and measurement take place in a flowing stream of 60% IPA. The scrubber and reactor columns also function as efficient filter media for any solid reaction products formed during passage of the sample through the column system.

15. Organic Solubles

The soluble fraction of particulate was obtained by solvent extraction from 500x500 mm Pallflex filters. Particulate on the large filter was collected from CVS-diluted exhaust using the 500x500 mm filter sampling system described in Section III. C. 1. of this report. The 500x500 mm filters were weighed before and after test to determine the weight of particulate matter collected. Each filter was extracted using methylene chloride in a Soxhlet apparatus (at times a large Soxhlet apparatus capable of holding up to sixteen filters was used to save time, effort, and materials in extracting filters combined from identical test schedules). Capacities of the regular and large Soxhlets were 400 mℓ and 3.8 ℓ, respectively. Solvent recycling periods were 15 minutes for eight hours with the regular Soxhlet and one hour for 48 hours with the large Soxhlet. The solvent volume was reduced under vacuum. The remaining solvent/solubles were transferred to a preweighed container, and the solvent was evaporated by nitrogen purging. The total mass of solubles was determined gravimetrically, and the percent of solubles in the particulate matter calculated. If needed, a weighed organic soluble sample was again redissolved in methylene chloride for splitting into separate samples. These samples were transferred into preweighed vials and dried for use in boiling point, CHN, Ames, and polarity profile analyses discussed subsequently in this section.

16. Benzo(a)pyrene (BaP)

Separate 500x500 mm particulate filters were employed in this program for benzo(a)pyrene analysis. In this case, the particulate was also collected from CVS-diluted exhaust using the same 500x500 mm filter sampling system previously discussed. Using a procedure developed at General Motors(11), the BaP is removed from the particulate by Soxhlet extraction with benzene/ethanol. The benzene/ethanol extract is re-extracted in hexane/methylene chloride. The solvent is then evaporated and the sample is re-dissolved in acetonitrile for analysis. BaP is analyzed with an HPLC system coupled to a fluorescence detector. The instrument used was a Perkin-Elmer 3B liquid chromatograph equipped with an MPF-44 fluorescence spectrophotometer. Excitation was at a wavelength of 383 nm, and emission was read at 430 nm.

17. Solubles Boiling Range and Individual N-Paraffin Analysis

Organic solubles extracted with methylene chloride from 500x500 mm particulate filters were subjected to analysis for boiling point range by FID gas chromatograph. The analysis was conducted by the U.S. Army Fuels and Lubricants Research Laboratory of the Energy Systems Research Division at SwRI. The gas chromatograph procedure used was a high-temperature variation on ASTM D2887-73 previously used on various SwRI projects(5,6) for EPA. The procedure provides a simulated distillation up to 600°C. Each aliquot was dissolved in methylene chloride, and an internal standard (C_9 through C_{11} paraffin composite) was added for quantitative results. The gas chromatograph used was a custom-built unit, equipped with dual hydrogen flame ionization detectors. Its column was 1.8 m (6 ft) long by 3.2 mm (1/8 in) diameter stainless steel, packed with 10 percent Dexsil 300 on 45/60 Chromosorb P, AW. It was programmed from 0° to 450°C at 15°C per minute after 2 minutes isothermal at 0°C. Data processing was performed on a Hewlett-Packard 3354 Laboratory Automated System.

18. Organic Solubles Carbon, Hydrogen, and Nitrogen

Aliquots of the dried, weighed methylene chloride soluble extract were submitted to Galbraith Laboratories and analyzed for carbon and hydrogen by the technique and instrumentation described in Section IV.A.13. (Perkin-Elmer 240B). Respective aliquots of the same samples were submitted to the U.S. Army Fuels and Lubricants Research Laboratory of the Energy Systems Research Division at SwRI for nitrogen analysis by oxidative pyrolysis and chemiluminescence.

19. Ames Bioassay

The Ames bioassay tests on organic solubles extracted from 500x500 mm Pallflex particulate filters using methylene chloride were conducted at the Southwest Foundation for Research and Education (SFRE), a sister organization of SwRI.

The Ames test as employed in this program refers to a bacterial mutagenesis plate assay with Salmonella typhimurium according to the method of Ames.(12) This bioassay determines the ability of chemical compounds or mixtures to cause mutation of DNA in the bacteria, positive results occurring when histidine-dependent strains of bacteria revert (or are mutated) genetically to forms which can synthesize histidine on their own. The observable positive indication of mutation is the growth of bacterial colonies on plates of nutrient media containing minimal histidine, with the number of revertants per amount of substance tested (or "specified activity") being the quantitative result. The observable negative indication is the lack of such growth. A third result occurs when the substance tested is toxic to the bacteria, but this result can not be interpreted in terms of mutagenesis.

SFRE used the Ames test procedure in detail, incorporating all recommended modifications since the original description. As provided for in the procedure, the tester strains were checked at recommended intervals for maintenance of stability and validity. Each selected extract was solvent exchanged with dimethyl sulfoxide (DMSO), a standard solvent compatible with the microorganisms. A solvent control run with each batch of test samples consisted of a blank filter extract treated in a manner similar to a test sample including solvent exchange with DMSO. The sample to be tested was diluted in DMSO to provide several different doses for each assay. Each does was assayed in triplicate with each of four tester strains selected in consultation with the Project Officer to be used in this program with respective test schedules as follows:

FTP extracts - Tester strains TA1535, TA1537, TA1538, TA98, all run with and without S-9 activation, except for TA1537 run without S-9 only.

HFET, NYCC, and 85 kph extracts - each run using tester strain TA98 without S-9.

The Aroclor-induced rat liver S-9 used for tester strain activation was checked to insure that enzyme activity was within the desired range, and was used within three months of preparation. Positive controls consisted of: sodium azide for TA1535 (0.5 micrograms per plate), 2-nitrofluorene for TA1538 and TA98 (5 micrograms per plate), and 9-aminoacridine for TA1537 (50 micrograms per plate). In the presence of the metabolic activation

activation system, 2-aminoanthracine (3 micrograms per plate) was used as positive control with all tester strains.

Several range-finding studies were conducted at SFRE with representative extracts obtained in this program. The range-finding studies are necessary to determine an appropriate range of concentrations to be used in definitive assays. An optimum range of concentrations to be used in obtaining dose-response information would include at least one dose level of the test material which is toxic to the tester organisms, and a range of concentrations sufficient to yield at least four points in the linear portion of the dose-response curve. On the basis of the range-finding studies, concentrations of 20, 60, 100, 200, 400, 600, and 1000 micrograms per plate were selected for use with all samples. Each sample was assayed twice in triplicate at each of the preceding concentrations, with or without S-9 activation as designated earlier in this discussion.

20. Polarity Profile

Soluble fractions of particulate extracted with methylene chloride, as described in IV.A.15, were used to determine polarity profile. The analysis method(13) employs a high-performance liquid chromatograph with a variable solvent program, which permits separation of the solubles into a series of fractions of increasing polarity. Instrumentation used in the analytical procedure included a Perkin-Elmer Series 3B HPLC utilizing a Perkin-Elmer MPF 44A fluorescence detector, and a Perkin-Elmer LC65T ultraviolet detector. BaP, 9-fluorenone, and acidine standards are injected to indicate the types of compounds eluted in each region of the chromatogram.

Initially, the solvent is composed of 95 percent hexane and 5 percent methylene chloride, a relatively non-polar mixture. This solvent mixture is used from the start of the chromatogram to 17 minutes into the elution period. During this period, non-polar compounds elute. BaP elutes at eight minutes into the run. Many non-polar PNA compounds also elute during this period, and give ultraviolet and fluorescence responses. After 17 minutes, the polarity of the solvent is increased at a rate of 5 percent methylene chloride per minute. During this transition period of solvent polarity, more polar compounds are eluted, giving fluorescence and ultraviolet spectra. At the end of this transition period (36 minutes into the run), the solvent is 100 percent methylene chloride and 9-fluorenone elutes. With 100 percent methylene chloride, even more polar compounds elute. Acridine elutes during this polar period (at about 70 minutes).

21. Exhaust Smoke Measurements

Exhaust smoke measurements were made using an optical light-extinction smokemeter, of the type specified in Federal regulations for heavy-duty diesel engine smoke certification.(14) The smokemeter was mounted on a 51 mm (2 in) O.D. tailpipe extension when in use. The control/readout unit for the smokemeter was mounted remote from the vehicle under test, and continuous recordings of smoke opacity were made concurrently with vehicle speed traces. Smoke measurements were made over the first 505 seconds of the cold-start FTP cycle, while the vehicle was operated on the chassis dynamometer. This procedure was developed for research purposes on an earlier EPA Contract, No. 68-03-2417.(15)

B. Validation and Qualification of Analytical Procedures

Validation and qualification experiments were carried out, as described in the Interim Report(8) in Section IV, for the purpose of determining the suitability of the analytical procedures initially selected for dilute exhaust analysis conducted on this project. The validation experiments determined if the sampling and instrument parameters were appropriate for the quantitative analysis of dilute exhaust. The qualification experiments determined if the compounds of interest could be quantitatively recovered from the CVS tunnel with and without the presence of exhaust in the tunnel. The analytical procedures validated and qualified are listed in Table 7 along with methods of sampling and analysis.

The sampling parameters for all procedures were found to be adequate for the collection of each of the unregulated emissions. All samples, with the exception of the organic sulfides and hydrogen sulfide are stable for several days and can be stored and rerun within hours after sampling to prevent loss of sample integrity. All instruments demonstrate linearity of response for expected concentration ranges (sample concentrations above the linear range must be diluted to concentrations that fall within the linear range of the instrument). The organic sulfides must be monitored carefully as traps containing over 200 ng of sample fall beyond the linear range of the FPD. The sample flow rate can be lowered to prevent overloading the Tenax trap. Test-to-test repeatabilities for all procedures are documented in this report. In most cases, repeatability is difficult to obtain at the lower concentrations, while the repeatability at high concentrations is easily obtained. Interferences were checked and documented for each

TABLE 7. ANALYTICAL PROCEDURES VALIDATED AND QUALIFIED

Compounds	Sampling	Analysis	Validation	Qualification
Aldehydes and Ketones	Impingers	DNPH, GC/FID	Yes	Yes
Organic Amines	Impingers	GC/NPD	Yes	Yes
Individual Hydrocarbons	Bags	GC/FID	Yes	Not required
Hydrogen Sulfide	Impingers	Meth. Blue, Spectrophotometer	Yes	Yes
Total Cyanide	Impingers	GC/ECD	Yes	Yes
Organic Sulfides	Traps	GC/FPD	Yes	Yes
Ammonia	Impingers	Ion Chrom.	Yes	Yes
Sulfate	Filters	BCA	Not required	Not required
Phenols	Impingers	GC-FID	Yes	Yes
BaP	Filters	Fluorescence, HPLC	Not required	Not required

procedure. Phthalates were found to interfere with the aldehyde and ketone procedure and may cause erroneous results for crotonaldehyde. In the hydrogen sulfide procedure, sulfur dioxide decreases the apparent hydrogen sulfide concentration, and its presence or absence must be recorded. The other procedures have interferences that can be avoided if care is taken.

Qualification experiments were carried out on the aldehyde and ketone, organic amine, hydrogen sulfide, total cyanide, organic sulfide, ammonia and phenol procedures to determine the recovery of known amounts of each pollutant from the CVS tunnel with and without exhaust (phenols CVS tunnel with exhaust only). Aldehydes and ketones, total cyanide and phenols can be recovered qualtitatively from the CVS tunnel with and without (not done for phenols) exhaust. There is a 10 percent loss of hydrogen sulfide with and without exhaust present. The organic amines, ammonia, and the organic sulfides experience significant losses in the CVS tunnel with and without exhaust. These losses must be taken into account when determining the concentration of these compounds in exhaust.

C. Minimum Detection Values for Unregulated Emissions

The minimum detection values (MDV) for various unregulated emissions, as determined in this project following guidelines discussed in other EPA programs(16,17,18), are included in Table 8. The MDV is defined as the value above which it can be said that the compound has been detected in the exhaust (i.e., the accuracy is equal to plus or minus the MDV at a measured value equal to the MDV). The MDV varies from one test cycle to another for the same pollutant because of variations in the sampling times (the shorter the sampling time, the larger the MDV).

TABLE 8. MINIMUM DETECTION VALUES (MDV) FOR UNREGULATED GASEOUS EMISSIONS

Emission Type	Minimum Detected Emission Rates, mg/km			
	FTP	HFET	NYCC	85 kph
Individual Hydrocarbons	0.93	0.38	2.58	0.33
Aldehydes and Ketones:				
Formaldehyde	0.19	0.14	1.23	0.08
Acetaldehyde	0.27	0.19	1.70	0.11
Acetone	0.33	0.24	2.10	0.14
Isobutyraldehyde	0.39	0.28	2.47	0.16
methylethylketone	0.39	0.28	2.47	0.16
crotonaldehyde	0.38	0.27	2.42	0.16
hexanaldehyde	0.48	0.35	3.09	0.20
benzaldehyde	0.50	0.36	3.20	0.21
Phenols	0.20	0.14	1.23	0.08
Hydrogen Sulfide	0.34	0.24	2.16	--
Total Cyanide	0.08	--[b]	--	--
Ammonia	0.17	--	--	--
Organic Sulfides:				
carbonyl sulfide	0.05	0.04	0.31	--
methyl sulfide	0.05	0.04	0.32	--
ethyl sulfide	0.07	0.05	0.47	--
dimethyl disulfide	0.08	0.06	0.49	--
Organic amines[a]				
methylamine	--	--	--	3
ethylamine	--	--	--	4
trimethylamine	--	--	--	5
diethylamine	--	--	--	6
triethylamine	--	--	--	8

[a] MDV of organic amines is μg/m^3 in raw exhaust
[b] Pollutant not sampled during this cycle

V. CATALYTIC TRAP-OXIDIZER REGENERATION

Catalytic trap-oxidizers used on the Fiat diesels were provided by the Johnson-Matthey Company branch located in Wayne, Pennsylvania. Messrs. Fred Enga and Miles Buckman of Johnson-Matthey provided technical assistance needed for the design, installation, and regeneration techniques of the traps. Mr. Enga described the two traps used in this program as, "JM-13 design incorporating a radial flow wire-mesh filter with a catalytic bed." The trap-reactors were similarly designed in stainless steel, and resembled conventional mufflers in shape. They both had diameters of 14.6cm (5 3/4in.) but different effective reactive lengths of 54.9cm (21 5/8 in.) for use with the naturally-aspirated diesel and 71.1cm (28 in.) for use with the turbocharged diesel. The trap used on the naturally-aspirated diesel illustrates the typical outer design and dimensions of the two traps, as shown in Figure 14. Each reactor was baffled to allow exhaust gas to flow around the perimeter of the can, enter the filter, flow radially through the annular active material into the hollow central core, and out the exit. The annular zone is of 11.7cm (4 5/8 in) outer diameter with a 5.1cm (2 in) diameter hole through its center. The active zones were 53.6 and 69.8 cm long in the traps used for the naturally-aspirated and turbocharged diesels, respectively.

This section describes the trap installations, trap temperatures and backpressures, and also, the techniques employed in regenerating the trap in the Fiat N.A. vehicle. Although some mention is made herein of the regulated gaseous and particulate emissions detected during trap regneration, the actual overall regulated and unregulated emissions results obtained

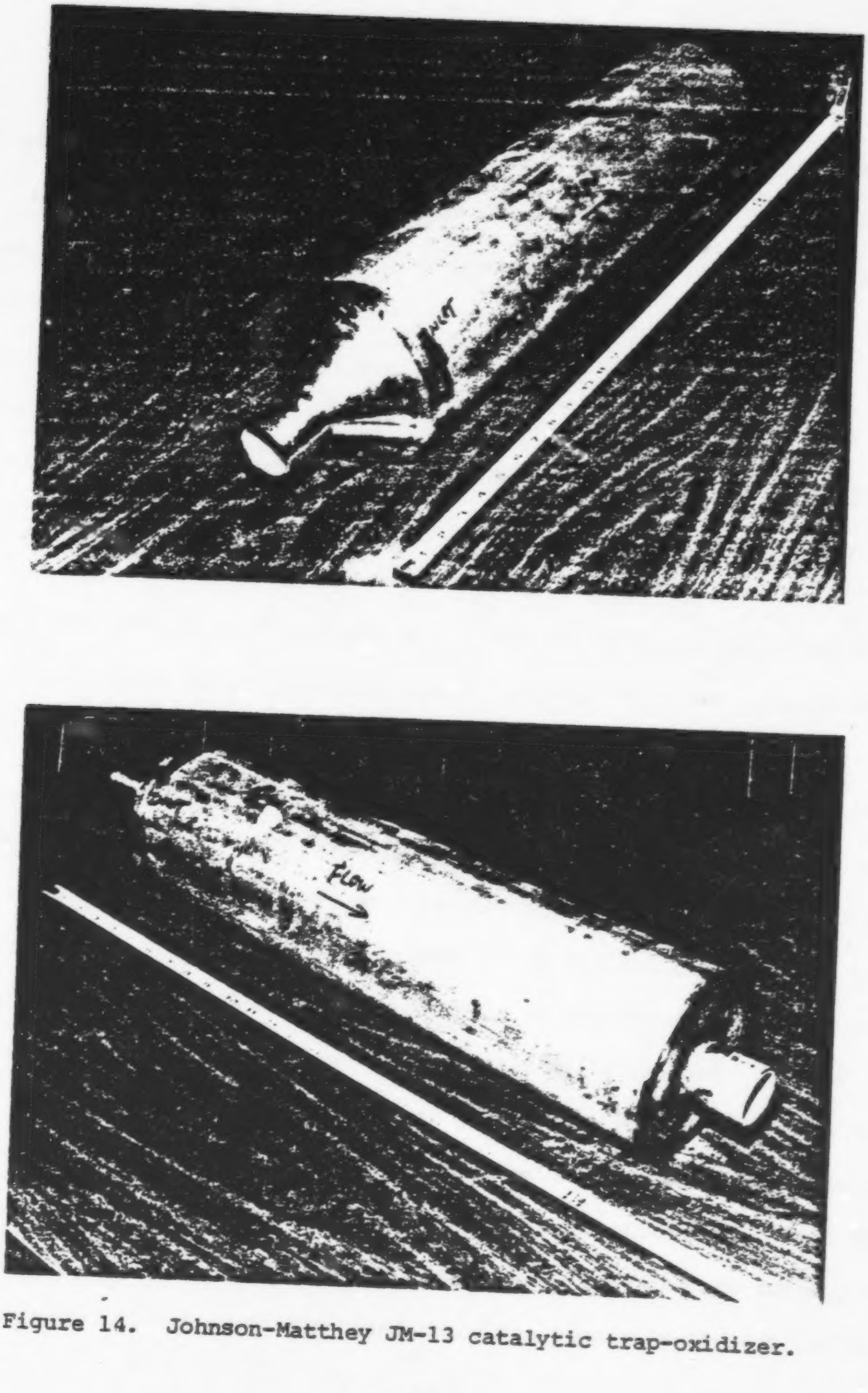


Figure 14. Johnson-Matthey JM-13 catalytic trap-oxidizer.

with the two traps are reserved for discussion in Section VI, VII and VIII of this report.

A. Fiat Naturally-Aspirated Diesel

The catalytic trap on the Fiat N.A. diesel was designed for use in close proximity to the engine exhaust manifold. The large dimensions of the trap and the limited space in the engine compartment made it quite difficult to adapt it to the vehicle exhaust system. The installation required that a 61 cm long extension of 5 cm O.D. mild-steel tubing be used between the trap inlet and engine exhaust manifold. A flange was welded to each end of the trap and corresponding ends of the extension tube and exhaust pipe. The extension tube was flared on its opposite end to connect it to the exhaust manifold. The extension was formed in a roughly helical shape to provide the shortest distance between trap and exhaust manifold, and to eliminate acute angle bends within the extension tube. A type K thermocouple was located at the immediate inlet and another at the outlet end of the trap to monitor temperatures. A second port was provided adjacent to the inlet thermocouple to provide access to the trap for pressure monitoring. A third port was installed on the extension tube, near the trap inlet thermocouple region, for propane injection during trap regeneration, if necessary.

A material obtained from Refractory Products and identified as WRP-X-AQ 2300°F ceramic fiber felt was employed for the trap insulation. Each sheet (61 x 91 x 0.64 cm) of the insulating material is packaged wet in a closed plastic container. One thickness of the wet material was formed around the entire trap, extension tube, exhaust manifold and assembly connectors. Several lengths of wire were wrapped around the insulation at appropriate locations to hold the insulation in place while it air-dried and hardened.

The initial conditioning of the trap was performed on the dynamometer at 80 kph steady-state for 32 km. The car exhaust was directed to outside air to avoid contamination of the CVS tunnel. According to Mr. Enga, the initial conditioning served to purge loose packing material retained in the trap during its manufacture. The backpressure of the trap ranged from 7.5 (initial) to 8.7 kPa (final). Trap temperatures averaged about 293°C for the inlet and 285° for the outlet.

After the trap was purged, the car exhaust was connected to the CVS tunnel and the following trap pressures and temperatures were recorded at indicated vehicle speeds:

Vehicle Speed, kph	Trap Back Pressure, kPa	Trap Temperature, °C Inlet	Trap Temperature, °C Outlet
64	5.0	226	209
80	7.5	279	229
96	10.7	367	288

Mr. Enga mentioned that for this type of trap, he expected approximately 6.0 kPa trap back-pressure at 64 kph, with regeneration required when back-pressure reached approximately 10.0 kPa at the same steady-state speed. Trap self-regeneration occurred when the trap outlet temperature exceeded 350°C. The trap could also be regenerated with the car in neutral and the engine at full rack (high idle) for two minutes, if it were deteremined that no engine damage would result.

The trap back-pressure and temperature were measured to monitor its operating characteristics during the proposed test plan with this car. Inlet and outlet trap temperatures were measured continuously using a two-pen recorder. The trap back-pressure was checked at 64 kph steady-state after each test sequence, using a Magnehelic guage calibrated in inches of water to determine regeneration requirements.

Summaries of the maximum inlet and outlet temperatures determined at the catalytic trap used with the Fiat N.A. diesel during the EM-329-F and EM-469-F fuel studies are found in Tables 9 and 10, respectively. Mileage accumulation on the trap during Runs 1 through 4 on each fuel amounted to approximately 216 mi (348 km). During all runs, there were few instances where the trap outlet temperatures exceeded 300°C. When trap outlet temperatures exceeded 300°C, such as in the HFET and 85 kph cycles with EM-469-F, the subsequent higher trap back-pressure did not indicate that significant trap regeneration had occurred. As noted in Tables 9 and 10, trap back-pressure as measured in fourth gear and at 64 kph steady-state after each four-run test sequence indicated backpressure was generally increasing. Additional testing besides that shown in Tables 8 and 9 was accomplished using the trap, mainly to generate 500 x 500 mm particulate filters. The resulting trap backpressures measured during the entire use of the trap with the Fiat N.A. diesel are listed in Table 11.

During the initial prep of the test car with EM-469-F at 11206 km, it was noted that the trap backpressure had increased to 9.5 kPa, as opposed to 6.7 kPa obtained at the end of EM-329-F testing. The abrupt and unexplained increase in trap backpressure required that trap regeneration be accomplished prior to proceeding with the EM-469-F tests in Table 10. As explained earlier, Mr. Enga recommended that trap regenertation be performed with the car in neutral and the engine at "high idle" (open rack) for two

TABLE 9. MAXIMUM INLET AND OUTLET TEMPERATURES OF JOHNSON-MATTHEY CATALYTIC TRAP USED ON FIAT NATURALLY-ASPIRATED DIESEL WITH EM-329-F BASE FUEL

Test Code Test Type Date (1981) Run No.	1B1F46 3-b FTP 4/6 1	1B1F50 3-b FTP 4/7 2	1B1F54 3-b FTP 4/9 3	1B1F58 3-b FTP 4/10 4	1B1H47 HFET 4/6 1	1B1H51 HFET 4/7 2	1B1H55 HFET 4/9 3	1B1H59 HFET 4/10 4
Trap Maximum Temp., °C.								
Inlet	318	368	360	339	335	348	348	342
Outlet	202	198	210	210	274	289	291	285

Test Code Test Type Date (1981) Run No.	1B1N48 NYCC 4/6 1	1B1N52 NYCC 4/7 2	1B1N56 NYCC 4/9 3	1B1N60 NYCC 4/10 4	1B1S49 85 kph 4/6 1	1B1S53 85 kph 4/7 2	1B1S57 85 kph 4/9 3	1B1S61 85 kph 4/10 4
Trap Maximum Temp., °C								
Inlet	198	233	210	210	282	291	305	293
Outlet	236	253	245	245	229	279	293	285
Backpress.,[a] kPa	--	--	--	--	5.5	6.0	6.7	6.7

[a] The trap backpressure was determined at 64 kph steady-state after each 85 kph cycle was completed; backpressure prior to initial testing with EM-329-F was 5.0 kPa.

TABLE 10. MAXIMUM INLET AND OUTLET TEMPERATURES OF JOHNSON-MATTHEY CATALYTIC TRAP USED ON FIAT NATURALLY-ASPIRATED DIESEL WITH EM-469-F FUEL

Test Code	1B2F64	1B2F68	1B2F72	1B2F76	1B2H65	1B2H69	1B2H73	1B2H77
Test Type	3-b FTP	3-b FTP	3-b FTP	3-b FTP	HFET	HFET	HFET	HFET
Date (1981)	4/15	4/16	4/20	4/21	4/15	4/16	4/20	4/21
Run No.	1	2	3	4	1	2	3	4
Trap Maximum Temp., °C								
Inlet	325	325	365	325	342	331	360	331
Outlet	204	198	243	245	283	268	314	314

Test Code	1B2N66	1B2N70	1B2N74	1B2N78	1B2S67	1B2S71	1B2S75	1B2S79
Test Type	NYCC	NYCC	NYCC	NYCC	85 kph	85 kph	85 kph	85 kph
Date (1981)	4/15	4/16	4/20	4/21	4/15	4/16	4/20	4/21
Run No.	1	2	3	4	1	2	3	4
Trap Maximum Temp., °C								
Inlet	210	210	245	224	289	293	--[b]	291
Outlet	236	222	249	274	274	285	--[b]	314
Backpress.,[a] kPa	--	--	--	--	7.7	7.7	8.7	9.2

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[a] The trap backpressure was determined at 64 kph steady-state after each 85 kph cycle was completed; backpressure prior to initial testing with EM-469-F was 7.5 kPa.

[b] Data not acceptable

TABLE 11. CATALYTIC TRAP BACKPRESSURE DETERMINED AT VARIOUS INTERVALS DURING EMISSIONS TESTING WITH FIAT NATURALLY-ASPIRATED DIESEL

Vehicle Odometer, km	Trap Cumulative Distance, km	Trap Backpressure kPa[a]
10823	Initial Conditioning	—
10892	69	5.0
10966	143	5.5
11051	228	6.0
11124	301	6.7
11206	383[b]	9.2
11330	507	7.5
11402	579	7.7
11484	661	7.7
11557	734	8.7
11646	823[b]	10.2
11711	888	7.7
11831	1008	8.0
11991	1168	8.5
12109	1286	9.5
12224	1401[b]	10.7
12271	1448	7.7
12417	1594	8.7
12509	1686[c]	12.4

[a] Trap backpressure measured at 64 kph steady-state

[b] Approximate accumulated kilometers where trap regeneration was required according to indicated high backpressure

[c] No further trap regeneration was attempted at completion of Fiat N.A. diesel testing

minutes. To forestall possible engine damage at full speed, an alternate trap regeneration procedure was tried. The procedure consisted of running the car in fifth gear and at 80 kph steady-state with incremental dynamometer horsepower increases. The dynamometer loading was continued to 20 hp (indicated) and the trap outlet temperature was noted to have increased to 394°C (inlet 430°C). The same test conditions were then sustained for an additional two minutes before the procedure was terminated with accompanying reduction of vehicle speed and dynamometer loading. A subsequent measure of trap backpressure showed no change from 9.5 kPa. Consequently, it was decided to regenerate the trap by using the car in neutral and the engine at "high idle". However, to help moderate the effect of maximum rpm on the engine, the engine was operated at this speed for one-half minute instead of two minutes. The procedure reduced the trap backpressure to 7.5 kPa, a value confirmed by Mr. Buchman to be adequate for resuming evaluation of the trap. Since the trap outlet temperature did not exceed 268°C (inlet 328°C) during the high idle procedure, it is conjectured that the decrease in trap backpressure occurred mostly through particulate purging instead of "light-off".

At 11646 kilometers and prior to starting the additional particulate sampling mentioned earlier for 500 x 500 mm filters, the catalytic trap backpressure on the Fiat N.A. diesel was 10.2 kPa. It was therefore necessary to regenerate the trap before beginning actual particulate sampling. With the Project Officer's approval, the Johnson-Matthey "high idle" (open rack) regeneration procedure of two minute duration was conducted, following a test sequence that allowed for repeated "high idle" test cycles. In this manner, sampling of regulated emissions could be similarly accomplished during "high idle" cycles for comparison during and after trap regeneration. The "high idle" trap regeneration test sequence is shown in Table 12, and corresponding computer sheets for the listed emissions tests are found in Appendix A.

Although three "high idle" cycles were completed, the trap backpressure was not greatly affected, as seen in Table 12. The first two "high idle" cycles demonstrated significantly higher emission rates generally than those found with the same car configuration and fuel on the 85 kph test cycles as reported later in Section VI of this report. The 85 kph average emission rates in grams/hr were HC (0.33), CO (0.92), NO_x (60), and particulate (4.6). The HC and particulate diminished after each "high idle" cycle in Table 12. The NO_x increased slightly after the first test, but remained rather uniform thereafter. The CO decreased and then stabilized after the first test. During each "high idle" cycle, the trap backpressure increased rapidly to the peak values noted in Table 12. It is interesting to note that the trap inlet temperature did not exceed 416°C during the "high idle" cycles. Studies conducted with a non-catalyzed trap at Ford Motor Company (19) indicated that trap regeneration could be achieved generally if the trap inlet temperature exceeded 482°C and if sufficient oxygen (2% or more) and time were provided. They showed that the actual exhaust temperature required for fast regeneration was usually higher than the nominal 482°C level to compensate for heat loss from the trap and exhaust system. Also, the same study indicated that catalysts did not lower the regeneration temperature of a particulate trap, nor did they accelerate the particulate oxidation process.

TABLE 12. "HIGH IDLE" TRAP REGENERATION TEST SEQUENCE USED ON NATURALLY-ASPIRATED FIAT WITH CATALYTIC TRAP AND EM-469-F FUEL

Test Sequence	Test Code	Test Cycle	Emissions Rate, g/hr				Catalytic Trap		
			HC	CO	NO_x	Part.	Max. Temp., °C		Max. Back-pressure kPa
							Inlet	Outlet	
1		23 minute FTP	--[a]	--	--	--	371	222	--
2		4 minute 64 kph S.S.	--	--	--	--	314	212	10.2
3		4 minute soak[b]	--	--	--	--	204	202	--
4	1B2R81	2 minute "high idle"	8.9	16.0	81.	59.	411	329	34.9
5		4 minute soak[b]	--	--	--	--	340	297	--
6		4 minute 64 kph S.S.	--	--	--	--	379	324	9.7
7		4 minute soak[b]	--	--	--	--	233	257	--
8	1B2R82	2 minute "high idle"	1.7	4.3	86.	33.	416	349	37.3
9		4 minute soak[b]	--	--	--	--	356	314	--
10		4 minute 64 kph S.S.	--	--	--	--	396	340	10.5
11		4 minute soak[b]	--	--	--	--	212	272	--
12	1B2R83	2 minute "high idle"	0.21	4.3	86.	27.	416	349	36.6
13		4 minute soak[b]	--	--	--	--	c	c	--
14		4 minute 64 kph S.S.	--	--	--	--	411	337	10.2

[a] -Emissions not sampled, trap backpressure not noted

[b] 4-minute soak also provided time for changing of particulate filters

[c] Data not acceptable

After the second "high idle" test in Table 12 failed to achieve trap regeneration, Mr. Buchman was contacted for further advice. His recommendation was to try a third "high idle" test before trying a different regeneration procedure. Mr. Enga was later advised of the results in Table 12. He recommended that a fast accel under an open rack engine condition be tried to regenerate the trap while operating the vehicle on the dyno. Since the Fiat N.A. diesel has a five-speed manual transmisson, it was decided to first carefully determine the open rack vehicle steady speeds in first, second, and third gears without actually regenerating the trap. This determination would later allow the fast and proper shifting of gears under open rack conditions, and would also permit measurement of regulated emissions during and after the trap regeneration. After running a preliminary 23-minute FTP and a 64 kph steady state of less than one minute, the car was returned to idle speed. With full rack in first gear, the car was carefully accelerated until its speed stabilized for twenty seconds before easing off open rack to shift to second gear, and then third gear, to also similarly determine their stabilized speeds. The first, second, and third gear stabilized speeds reached were 42, 73, and 108 kph, respectively. Maximum inlet (outlet) temperatures obtained at the three stabilized speeds were 382°C (256°C) in first gear, 461°C (348°C) in second gear, and 651°C (439°C) in third gear. A subsequent check of the trap backpressure, as normally performed at 64 kph, indicated a value of 7.7 kPa. This trap backpressure was close to the value observed after the trap regeneration conducted at 11,330 kilometers. Since the opportunity for obtaining regulated emissions during the trap regeneration was lost, the car was subsequently prepped to continue sampling particulate on 500 x 500 mm filters.

The final trap regeneration was accomplished at approximately 12,224 kilometers by vehicle operation on the dyno. After an initial fifteen-minute warm-up at 64 steady-state speed, the vehicle was brought to idle. From idle, the vehicle was quickly accelerated at full rack in a first, second, and third gear succession to reach a steady-state speed of 108 kph for thirty seconds. Four consecutive accels were necessary using the same trap regeneration accel procedure in order to reduce the trap backpressure from 10.7 to 7.7 kPa in steps of 1.0, 0.7, 0.5, and 0.8 kPa, respectively. The average maximum inlet temperature of the trap was 642°C (462°C outlet) during the third gear portion of the trap regeneration procedure.

No further trap regenerations were attempted, as shown in Table 11, for the remainder of the test plan on the trap-equipped Fiat N.A. diesel. After completion of the tests run for particulate accumulation, the catalytic trap was removed from the Fiat N.A. diesel and saved for future shipment to Johnson-Matthey. The Fiat N.A. diesel exhaust system was then restored to its original configuration. At the request of Miss Sharon Quayle, and with the approval of the Project Officer, the vehicle was shipped to the Department of Transportation in Cambridge, Massachusetts, on June 22, 1981.

B. Fiat Turbocharged Diesel

The catalytic trap-oxidizer for use on the Fiat turbocharged diesel was designed for "underfloor" installation because of the vehicle's limited engine compartment space. A flange was welded to each end of the trap for its underfloor installation immediately past the firewall of the

Fiat T.C. diesel. Prior to installation, the trap was fitted with a type K thermocouple at its inlet and outlet. A separate port was provided near the inlet thermocouple for pressure monitoring. Insulation of the trap was with a single layer of Refractory Products WRP-X-AQ 2300°F ceramic fiber felt. The same type insulation was used to cover the exhaust pipe section extending from the turbocharger down to the trap. The asbestos tape originally wrapped around the pipe section was left intact underneath the fiber felt layer. Both the trap and pipe extension fiber felt insulation was wrapped with several lengths of wire and then with asbestos and glass tape for increased protection. The size and installation of the trap on the vehicle permitted only a few inches clearance between the trap and laboratory floor.

The trap was conditioned on the dynamometer for 80 kilometers at alternating vehicle speeds of 48, 64, 80 and 96 kph. After trap conditioning, the car exhaust was connected to the CVS tunnel, and the trap pressure and temperature were recorded at the following vehicle speeds:

Vehicle Speed, kph	Trap Back-Pressure, kPa	Trap Temperature, °C	
		Inlet	Outlet
64	4.5	283	307
80	7.2	293	272
96	12.4	339	301

The clean trap back-pressure, according to Mr. Buchman, should have been approximately 3.5 kPa at 64 kph. Trap regeneration is recommended at or close to 8.7 kPa. For this study, trap inlet and outlet temperatures, were measured continuously using a two-pen recorder. The trap back-pressure was checked in fourth gear and at 64 kph after completion of each test.

sequence consisting of a 4-bag FTP, HFET, NYCC, and 85 kph.

The maximum inlet and outlet temperatures measured at the catalytic trap during regulated and unregulated emissions testing are found in Table 13 for EM-329-F, and in Table 14 for EM-469-F. Mileage accumulation on the trap during Runs 1 and 2 on each fuel amounted to approximately 159 kilometers. As indicated in Tables 13 and 14, the highest trap inlet temperatures (290 to 300°C) with each fuel occurred during the HFET cycle; but they were short of the approximately 480°C or higher temperature needed for self-regeneration of the trap.

Total distance accumulated on the trap during all testing conducted, including repetitive testing for particulate accumulation using 500 x 500 mm filters, was 1,411 kilometers, as summarized in Table 15. No trap regeneration was required during the extended period of emissions testing with the Fiat T.C. diesel using catalytic trap and the two test fuels. In the single instance where trap backpressure actually approached the proposed upper limit of 8.7 kPa for the trap (at 9.308 km), a subsequent run employing a NYCC proved sufficient to reduce trap backpressure to 7.2 kPa. Thereafter, the trap backpressure remained at 7.2 kPa or slightly below, as indicated in Table 15.

An earnest effort was also made to run the Fiat T.C. diesel with a manifold catalytic trap. Mr. Buchman visited SwRI on June 9, 1981 to take preliminary pictures and measurements of the Fiat T.C. engine compartment. Johnson-Matthey was to design and manufacture a catalytic trap-oxidizer to use in place of the engine exhaust manifold. The design would allow the trap to be located immediately ahead of the turbocharger. During

TABLE 13. MAXIMUM INLET AND OUTLET TEMPERATURES OF JOHNSON-MATTHEY UNDERFLOOR CATALYTIC TRAP USED ON FIAT TURBOCHARGED DIESEL WITH EM-329-F FUEL

Test Code Test Type Date (1981) Run No.	3B1F01 3-b FTP 9/17 1	3B1F05 3-b FTP 9/18 2	3B1H02 HFET 9/17 1	3B1H06 HFET 9/18 2	3B1N03 NYCC 9/17 1	3B1N07 NYCC 9/18 2	3B1S04 85 kph 9/17 1	3B1S08 85 kph 9/18 2
Trap Maximum Temp., °C								
Inlet	255	255	285	290	210	215	274	278
Outlet	210	212	255	265	193	192	265	270
Trap Backpressure kPa[a]	---	---	---	---	---	---	5.0	5.0

[a] The trap backpressure was determined at 64 kph steady-state after each 85 kph cycle was completed; backpressure prior to initial testing with EM-329-F was 4.5 kPa.

TABLE 14. MAXIMUM INLET AND OUTLET TEMPERATURES OF JOHNSON-MATTHEY UNDERFLOOR CATALYTIC TRAP USED ON FIAT TURBOCHARGED DIESEL WITH EM-469-F FUEL

Test Code Test Type Date (1981) Run No.	3B2F35 3-b FTP 9/23 1	3B2F39 3-b FTP 9/24 2	3B2H36 HFET 9/23 1	3B2H40 HFET 9/24 2	3B2N37 NYCC 9/23 1	3B2N41 NYCC 9/24 2	3B2S38 85 kph 9/23 1	3B2S42 85 kph 9/24 2
Trap Maximum Temp., °C								
Inlet	268	262	300	298	195	198	284	285
Outlet	220	218	274	270	220	220	275	275
Trap Backpressure kPa[a]	---	---	---	---	---	---	6.7	6.5

[a] The trap backpressure was determined at 64 kph steady-state after each 85 kph cycle was completed; backpressure prior to initial testing with EM-469-F was 6.7 kPa.

TABLE 15. CATALYTIC TRAP BACKPRESSURE DETERMINED AT VARIOUS INTERVALS DURING EMISSIONS TESTING WITH FIAT TURBOCHARGED DIESEL

Vehicle Odometer, km	Trap Cumulative Distance, km	Trap Backpressure, kPa[a]
8355	Initial Conditioning	--
8497	142	4.5
8571	216	5.0
8656	301	5.0
8796	441	5.5
8951	596	6.7
9022	667	6.7
9110	755	6.5
9257	902	7.7
9308	953	8.5
9310	955	7.2
9328	973	7.2
9596	1241	7.2
9766	1411	7.0

[a] Trap backpressure measured at 64 kph steady-state

his visit to SwRI on June 17, 1981, Dr. Rinaldo Rinolfi of Fiat (Italy) agreed to provide Mr. Buchman with essential engineering drawings of the engine, exhaust manifold, and turbocharger to assist him further in the manifold trap design. Fiat was also to supply SwRI with the necessary gaskets required for fitting the completed manifold trap to the engine.

The Fiat engineering drawings and gaskets were received at SwRI on August 6, 1981. The drawings were quickly forwarded to Mr. Buckman, who subsequently determined that the drawings were not applicable to the Fiat T.C. diesel at SwRI. Fiat was alerted of the mistake, and the correct drawings were finally received by the Project Officer in late October 1981. After studying the drawings, Mr. Buckman determined that the trap was more complex than anticipated, and could therefore not be completed until late 1981 or even early 1982. The Project Officer, along with SwRI, determined that the projected delay in the trap acquisition was too long to accommodate within the present time and monetary constraints of the project. Therefore, it was decided that the underfloor trap configuration of the turbocharged Fiat diesel would be the final vehicle configuration evaluated, and that the remaining project effort would be applied to data analysis and preparation of the Final Report.

VI. REGULATED EMISSIONS AND FUEL ECONOMY RESULTS

A discussion of the regulated emissions and fuel economy results obtained during the testing conducted in this project is presented in this section. The testing for regulated emissions provided a large amount of data generated using a four-cycle test sequence, composed of a 4-bag FTP, HFET, NYCC, and 85 kph steady-state. The emissions evaluations included five diesel vehicle configurations (Fiat N.A., Fiat N.A./trap, 1981 Oldsmobile Cutlass, Fiat T.C., and Fiat T.C./trap and two test fuels (EM-329-F and EM-469-F). The regulated emissions and fuel economy data for individual runs and respective computer sheets for each vehicle configuration/fuel type are found in Appendices B, C, D, E, and F for the five vehicle configurations in the order listed above. The individual run data have been grouped, averaged, and tabulated in this section in order to effectively compare the pollutants and fuel economy, by vehicle, driving cycle, and fuel. These data for HC, CO, NO_x, particulate, and fuel economy are summarized in Tables 16 through 20 respectively.

Test-to-test repeatability of emissions and fuel economy data used in the preparation of Tables 16 through 20 was generally good. However, some significant variations in particulate emission rates were noted for the Fiat N.A./trap configuration with both fuels in the NYCC and 85 kph, as shown in summary tabulations on pages C-2 and C-19. In the NYCC, for example, the test-to-test particulate rate of the Fiat N.A./trap vehicle varied by a factor of three with EM-329-F, and by a factor of two with EM-469-F. The reason for the sporadic variation in particulate rate in some driving cycles

TABLE 16. VEHICLE, FUEL, AND TEST CYCLE COMPARISONS FOR AVERAGE HYDROCARBONS

Vehicle	Average HC Emission Rates (g/mi) by Cycle and Fuel							
	3-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	0.49	0.57	0.23	0.25	0.79	1.10	0.19	0.19
Fiat N.A./ trap	0.08	0.10	0.02	0.03	0.04	0.04	0.00	0.01
Fiat T.C.	0.39	0.48	0.11	0.12	1.06	1.26	0.07	0.10
Fiat T.C./ trap	0.12	0.19	0.03	0.03	0.19	0.30	0.00	0.01
Cutlass	0.19	0.21	0.13	0.16	0.45	0.52	0.13	0.13

TABLE 17. VEHICLE, FUEL, AND TEST CYCLE COMPARISONS FOR AVERAGE CARBON MONOXIDE

Vehicle	Average CO Emission Rates (g/mi) by Cycle and Fuel							
	3-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	1.66	1.90	0.67	0.70	2.93	3.80	0.55	0.54
Fiat N.A./ trap	0.29	0.41	0.05	0.07	0.15	0.20	0.03	0.02
Fiat T.C.	1.35	1.58	0.45	0.50	3.08	3.47	0.39	0.43
Fiat T.C./ trap	0.43	0.43	0.08	0.08	0.64	0.72	0.05	0.05
Cutlass	1.05	1.11	0.70	0.72	2.42	2.51	0.66	0.70

TABLE 18. VEHICLE, FUEL, AND TEST CYCLE COMPARISONS FOR AVERAGE NO_x

Vehicle	Average NO_x Emission Rates (g/mi) by Cycle and Fuel							
	3-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	1.32	1.40	0.88	0.98	2.02	2.25	0.86	0.96
Fiat N.A./ trap	1.48	1.59	1.10	1.16	2.36	2.26	1.11	1.13
Fiat T.C.	2.04	2.02	1.27	1.28	2.73	2.74	1.30	1.22
Fiat T.C./ trap	1.87	2.09	1.15	1.34	2.63	2.92	1.18	1.35
Cutlass	1.03	1.05	0.60	0.61	2.32	2.40	0.59	0.58

TABLE 19. VEHICLE, FUEL, AND TEST CYCLE COMPARISONS FOR AVERAGE PARTICULATE

Vehicle	Average Particulate Emission Rates (g/mi) by Cycle and Fuel							
	3-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	0.41	0.45	0.27	0.34	0.43	0.62	0.25	0.30
Fiat N.A./ trap	0.11	0.07	0.09	0.06	0.36	0.16	0.12	0.09
Fiat T.C.	0.26	0.33	0.13	0.13	0.41	0.52	0.11	0.11
Fiat T.C./ trap	0.10	0.09	0.06	0.07	0.15	0.17	0.06	0.08
Cutlass	0.38	0.44	0.21	0.21	0.57	0.66	0.16	0.14

TABLE 20. VEHICLE, FUEL, AND TEST CYCLE COMPARISONS FOR AVERAGE FUEL ECONOMY

Vehicle	Average Fuel Economy (mi/gal) by Cycle and Fuel							
	3-Bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	27.6	27.4	42.2	39.3	19.0	16.6	43.0	39.9
Fiat N.A./ trap	28.2	28.8	37.9	38.9	18.1	18.6	38.4	39.7
Fiat T.C.	22.7	23.0	36.6	37.0	14.5	14.7	37.3	37.5
Fiat T.C./ trap	23.4	23.7	37.9	36.9	14.7	14.8	38.3	38.2
Cutlass	22.0	22.1	31.6	32.7	11.3	11.3	32.1	33.5

is not known. However, it is conjectured that different levels of sulfate and/or particulate purged from the overall exhaust system may have contributed to the observed different particulate emission rates.

Comparative FTP regulated emissions and fuel economy data obtained from DOE-Bartlesville(4) for the two Fiats without exhaust aftertreatment and from the EPA Certification Division for a 1981 Oldsmobile Cutlass diesel were as follows:

FTP REGULATED EMISSIONS RATE, g/mi

Vehicle	Fuel	HC	CO	NO_x	Particulate	Fuel Economy, mi/gal
Fiat N.A.	2D	0.68	2.32	1.61	0.34	27.3
	"European"	0.49	1.64	1.45	0.45	27.8
Fiat T.C.	2D	0.55	1.80	3.12	0.32	23.7
Cutlass	Emissions 2D	0.41	1.13	1.30*	(not sampled)	21.7
1981 Federal Standard(23)		0.41	3.4	1.0	0.6	--

*NO_x waived to 1.50 g/mi for 1981

The 2D fuel at DOE was higher in aromatics and density than EM-329-F. The "European" fuel was more similar to EM-329-F, except for its wider boiling range. The "European" fuel results are very close to the SwRI results with the same car, perhaps due to fuel similarity. The FTP 1981 Federal Standard[23] for HC (0.41 g/mi) was exceeded by the Fiat N.A. (no trap/both fuels) and Fiat T.C. (no trap/EM-469-F), as shown in Table 16. In addition, the 1981 NO_x limit (1.0 g/mi) was exceeded by each vehicle/fuel combination in the FTP, as indicated in Table 18. For 1981, however, the Cutlass was granted a NO_x waiver of 1.50 g/mi.

With each fuel, as shown in Table 16, the highest HC was obtained using the naturally-aspirated diesel without trap in the FTP, HFET, and 85 kph, and using the turbocharged diesel without trap in the NYCC. The trap-equipped Fiats consistently provided the lowest HC in the study, with the Fiat T.C./trap vehicle showing higher HC in the FTP and NYCC. On a fuel-to-fuel basis with all vehicles, HC emissions were generally higher with EM-469-F than with EM-329-F, but not substantially so. On all vehicles and test fuels, HC was highest in the FTP and NYCC, with the NYCC displaying the higher values overall.

The use of trap-catalysts served to reduce the Fiat N.A. and T.C. diesels' HC emissions in all cycles and with both fuels as show in Table 16. The effective reduction of HC with the trap was greater than 82 percent (91 avg.) and 60 percent (78 avg.) on the Fiat N.A. and T.C. diesels, respectively. The Cutlass HC on the FTP was lower than the Fiats without aftertreatment, but higher than the same vehicles with aftertreatment.

In the summary of average CO emissions in Table 17, CO was generally higher, although not appreciably so, with EM-469-F. With both fuels, the

Fiats without aftertreatment provided highest CO during the FTP and NYCC. The Cutlass produced somewhat higher CO than the Fiats without traps in the HFET and 85 kph using each fuel. The decrease in CO emissions obtained with the traps for all cycles and fuels was greater than 78 percent (91 avg.) and 68 percent (80 avg.) on the Fiat N.A. and T.C. vehicles, respectively.

Most vehicles and test cycles listed in Table 18 indicated slightly higher NO_x with EM-469-F than with EM-329-F. The Fiat T.C. vehicle produced the highest NO_x in each cycle with EM-329-F, while the same vehicle with aftertreatment had the highest NO_x in each cycle with EM-469-F. The use of the catalytic trap on the naturally-aspirated diesel with both fuels consistently increased NO_x emissions on the average of 17 percent over the same vehicle without aftertreatment. The Fiat T.C. diesel with trap had consistently lower NO_x (average of eight percent) with EM-329-F, but consistently higher NO_x (average of six percent) with EM-469-F over the same vehicle without exhaust aftertreatment. The effect of trap backpressure on NO_x emissions reported in Table 18 for the Fiats is not known, since trap backpressure was not monitored continuously during any emissions testing performed in this study.

The highest particulate emissions, as summaried in Table 19, were produced by the Fiat naturally-aspirated diesel in the FTP, HFET,.and 85 kph with both fuels. The Cutlass had the highest particulate rate on both test fuels in the NYCC. Generally, the catalytic trap-equipped Fiats had the lowest particulate emissions levels as shown in Table 19. These same vehicles also demonstrated nearly identical particulate emissions in the FTP with EM-329-F, and in the HFET, NYCC, and 85 kph with EM-469-F.

Although no major differences in particulate emission with respect to fuel type are generally found in Table 19, by vehicle or driving cycle, some trends in particulate rates can be noted. Slightly lower particulate emissions were shown with EM-329-F than with EM-469-F for the Fiat N.A. diesel without aftertreatment in all test cycles, and for both the Fiat T.C. diesel without aftertreatment and, the Cutlass in the FTP and NYCC. The Fiat N.A. diesel with catalytic trap emitted more particulate in all cycles with EM-329-F than with EM-469-F. On the NYCC with EM-329-F however, the same vehicle showed more than twice the particulate rate obtained with EM-469-F. This substantial difference in particulate rate between fuels is attributed to the noticeable spread of particulate emissions obtained on the NYCC with the Fiat N.A./trap vehicle, as discussed earlier in this section.

Particulate emissions of the Fiats were lower in every cycle and fuel combination with the catalytic traps than without them. With trap use, the particulate emission rates of the Fiat N.A. and T.C. diesels were reduced by an average of 65 to 55 percent, respectively. The largest particulate decreases with each trap-equipped Fiat occurred in the FTP using EM-469-F, where the Fiat N.A. showed an 84 percent reduction and the Fiat T.C. exhibited a 73 percent reduction.

Fuel economy results in Table 20 indicate that generally the highest fuel economy was obtained by the naturally-aspirated Fiat with and without exhaust aftertreatment. The Cutlass had the lowest fuel economy overall, although it was only slightly less than that obtained with either exhaust configuration of the turbocharged Fiat in the FTP with the two fuels. With each test vehicle and fuel in the study, fuel economy was highest in the 85 kph and lowest in the NYCC, as expected.

No obvious trends were observed for fuel economy between fuels, although the Fiat N.A. without aftertreatment showed the largest differences between fuel types. The result may be seen in Table 20 under the HFET, NYCC, and 85 kph procedures, where EM-329-F showed the higher mileage per gallon, but by not more than 3.1 mi/gal in any cycle.

When the trap was put on the Fiat N.A. diesel, fuel economy with the test fuels increased very slightly in the FTP, but decreased in the HFET, the NYCC (EM-329-F), and at 85 kph. The largest fuel economy decreases noted in the trap studies of the Fiats occurred using the Fiat N.A. diesel in the HFET and 85 kph with fuel EM-329-F. No significant change in fuel economy occurred between the different exhaust configurations of the Fiat turbocharged diesel with either fuel.

VII. UNREGULATED GASEOUS EMISSIONS RESULTS

This section is devoted to the discussion of the unregulated gaseous emission results which included sampling and analyses of individual hydrocarbons, aldehydes, ammonia, phenols, total cyanide, trap-collected gaseous hydrocarbons, organic sulfides, hydrogen sulfide, amines, and N-nitrosamines. The respective pollutants are discussed separately, usually with individual run data grouped, averaged, and tabulated. Where an analysis includes several pollutants, as in the case with individual hydrocarbons, aldehydes, phenols, organic sulfides, amines, and N-nitrosamines, comparison of pollutants to vehicle, driving cycle, and fuel relied more on the average "total" emissions for simplicity.

A. Individual Hydrocarbons

The emission rates of eight individual hydrocarbons (IHC) consisting of methane, ethylene, ethane, acetylene, propane, propylene, benzene, and toluene were measured in this project. The summaries of individual runs obtained with each vehicle configuration, driving cycle, and fuel are found in Appendix G, Tables G-1 through G-10.

Replicate runs in Appendix G using the cold FTP and hot FTP indicated good repeatability of the more highly concentrated IHC species identified as methane, ethylene, acetylene, and propylene. Methane, ethylene, and ethane were the only pollutants found consistently with each vehicle and fuel combination. Although data scatter in the overall study made it difficult to identify precise trends, it was found that ethylene was generally present at the highest concentration among the IHC species for each vehicle, cycle, and fuel combination. Usually, the ethylene accounted for at least half of the "total" IHC. While there were a few exceptions, such as indicated in Tables G-1 and G-3 for the FTP's, most IHC species detected for the Fiat vehicles without catalytic traps were found at lower levels for these vehicles with catalytic traps. In most cold and hot FTP's, the Cutlass emitted lower concentrations of all the IHC except toluene than did the Fiats without exhaust aftertreatment. In the cold FTP and hot FTP, ethylene was slightly higher with EM-469-F than with EM-329-F for all vehicle configurations.

Table 21 summarizes the average "total" IHC emission results prepared from individual run data in Appendix G. For comparative purposes, the summary includes the average "total IHC" obtained via continuous heated FID. The "total" IHC or just IHC, as used in this discussion, was highest on the Fiat N.A. vehicle without aftertreatment, and with both fuels in the hot FTP, HFET, and NYCC. Displaying highest IHC emissions in the cold FTP were the naturally-aspirated Fiat with no aftertreatment using EM-469-F, and the turbocharged Fiat with no aftertreatment using EM-329-F. With both fuels, IHC was highest in the 85 kph with the Cutlass. The lowest IHC ranged from 0.96 to 26 mg/km, and was mainly associated with the turbocharged Fiat/trap and Cutlass diesels. The lowest IHC emissions in the study were generated by the Fiat T.C./trap configuration in the hot FTP with both fuels, and in the HFET, NYCC, and 85 kph with fuel EM-329-F. The Cutlass "total" IHC was lowest on the cold FTP with both fuels and in the NYCC with EM-469-F.

On a fuel comparison basis, the EM-469-F fuel gave higher IHC emissions in eighty percent of the cases. The differences between fuels were rather

TABLE 21. SUMMARY OF AVERAGE "TOTAL" INDIVIDUAL HC RESULTS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESLES

Vehicle	Average "Total" IHC Emission Rates (mg/km) by Cycle and Fuel									
	Cold FTP		Hot FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	65	82	56	69	20	27	157	153	13	6.8
FID "Total"										
HC", mg/km	--[a]	398	--	388	--	140	--	700	--	130
Fiat N.A./trap	28	29	20	25	6.2	8.1	41	44	2.4	1.1
FID "Total										
HC", mg/km	56	53	36	49	10	20	30	40	7.0	b
Fiat T.C.	68	76	36	47	10	5.4	120	68	4.7	4.6
FID "Total										
HC", mg/km	276	367	227	263	70	70	690	800	50	60
Fiat T.C./trap	31	46	9.6	11	2.4	13	36	81	0.96	4.3
FID "Total										
HC" mg/km	98	162	51	66	10	20	120	190	b	b
Cutlass	23	26	20	18	17	16	39	37	16	13
FID "Total										
HC", mg/km	118	134	134	158	80	100	320	320	70	80

[a] data not acceptable
[b] less than 5 mg/km

minor, however. Also IHC was noted to vary with test cycle for the majority of vehicle configuration with both fuels. In this respect, rank ordering of "total" IHC emissions by test cycle was fairly consistent in the order NYCC, cold FTP, hot FTP, HFET, and 85 kph, from highest to lowest "total" IHC.

Trap-catalysts reduced the IHC emissions of the Fiat N.A. and T.C. diesels in all cycles and with both fuels, except in the NYCC and 85 kph using EM-469-F with the Fiat T.C./trap configuration. For some reason, propane in larger quantities than usual was found in these two cycles, thereby causing greater "total" IHC values. Nevertheless, the average effective reduction of "total" IHC emissions with the use of the catalytic traps on the Fiat N.A. and T.C. diesels amounted to 70 and 48 percent, respectively. By comparison, the average reductions in FID "total" HC with catalytic trap (Table 21) were 91 percent on the Fiat N.A. diesel and 79 percent on the Fiat T.C. diesel.

B. Aldehydes

The emission rates of ten aldehydes and ketones consisting of formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, isobutyraldehyde, methylethylketone, crotonaldehyde, hexanaldehyde, and benzaldehyde were measured in this project. The aldehydes and ketones are formed by the partial oxidation of the fuel hydrocarbons. Acetone, acrolein, and propionaldehyde were not resolved from each other using the normal gas chromatographic operating conditions and all three have been reported together as acetone.

The individual run summaries for aldehyde emissions from each vehicle configuration, cycle, and fuel are presented in Appendix H, Tables H-1 through H-10. The only aldehydes detected in the vehicles exhaust during this study were formaldehyde, acetaldehyde, acetone, isobutyraldehyde, methylethylketone, and benzaldehyde. The emission rates of benzaldehyde could not be measured accurately in this project due to interferences in the analysis procedure. In addition, as seen in Tables H-2 through H-6 and Table H-10, the isobutyraldehyde emissions were much higher than expected. These unexpectedly high isobutyraldehyde emission rates were of concern to the Project Officer, and at this request, the two NYCC aldehyde samples listed in Table H-2 were dried and shipped to Mr. Frank Black at EPA/RTP for their analysis using HPLC and mass spectroscopy techniques. A copy of the letter to Mr. Black describing the two NYCC samples and their drying technique is presented in Appendix H. Since the identities of the isobutyraldehyde and benzaldehyde have not been confirmed in this study, their emission rates in various summaries of Appendix H are included for information only. Further, the two compounds are not included in the "total" aldehyde emission rates found in the same summaries.

Formaldehyde was the only aldehyde detected with all vehicles and fuels, as seen in Tables H-1 through H-10. Overall, the aldehyde emissions data showed considerable scatter. Acetaldehyde, acetone, and methylethylketone emissions appeared in only a few cycles during the study and along with formaldehyde, did not provide obvious trends.

A summary of the average formaldehyde and "total" aldehyde emissions, prepared from individual run data given in Appendix H, is presented in Table 22. Formaldehyde, a known carcinogen, was generally the largest portion of the "total" aldehydes evaluated, and at times was also the only aldehyde detected. The highest formaldehyde emissions were those from the Fiats without aftertreatment, but more so with the naturally-aspirated configuration. With trap use, formaldehyde was reduced by more than 53 percent on the naturally-aspirated Fiat, and by more than 43 percent on the turbocharged Fiat. The FTP formaldehyde emissions on the Fiats without aftertreatment were generally comparable to those found with a 1977 non-catalyst gasoline car in another EPA study(16) conducted at this laboratory. In the same study(16), low mileage 1978 oxidation catalyst-equipped gasoline cars produced FTP formaldehyde emissions similar to those found with the trap-equipped Fiats and the Cutlass.

"Total" aldehydes were consistently highest overall from the naturally-aspirated

TABLE 22. SUMMARY OF AVERAGE FORMALDEHYDE AND "TOTAL" ALDEHYDES EMISSIONS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Measured Aldehydes	Average Aldehydes Emission Rates (mg/km) by Cycle and Fuel									
		Cold FTP		Hot FTP		HFET		NYCC		85 kph	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	Formaldehyde	8.0	7.8	6.5	12	4.4	1.6	13	19	1.5	2.0
	"Total"	12	8.1	12	13	7.2	1.6	40	24	5.2	3.3
Fiat N.A./ Trap	Formaldehyde	1.7	2.4	0.75	1.4	0	0.75	0	0	0	0
	"Total"	1.7	2.4	0.75	1.4	0	0.75	0	0	0	0
Fiat T.C.	Formaldehyde	2.2	5.3	1.8	5.2	0.55	0.10	6	9	0.31	0
	"Total"	7.0	5.3	11	5.2	1.4	0.10	6	9	3.1	0
Fiat T.C./ Trap	Formaldehyde	0	0.55	0	0	0	0	3.4	0	0	0
	"Total"	0	0.55	0	0	0	0.49	20	12	0	0.70
Cutlass	Formaldehyde	1.0	1.1	1.2	0	0	0	0	0	0	0
	"Total"	1.0	1.1	1.2	0	0	0	0	0	0	0

Fiat without aftertreatment. The turbocharged Fiat without aftertreatment gave second highest "total" aldehyde emissions in the cold FTP and hot FTP with both fuels. The lowest "total" aldehydes were mainly associated with the Fiat N.A./trap, Fiat T.C./trap, and Cutlass diesels. Although fuel and driving cycle influences on "total" aldehydes were not too apparent, the available data show clearly that the highest "total" aldehydes with the Fiat N.A. diesel, and also the Fiat T.C. trap configuration occurred in the NYCC with both fuels. Also, aldehydes on the Cutlass were found only during the cold FTP with both fuels, and on the hot FTP with EM-329-F.

The use of a catalytic trap on the Fiat N.A. diesel reduced "total" aldehydes overall by 53 percent in one case, and by more than 86 percent in most cases. On the Fiat T.C./trap configuration, "total" aldehydes were reduced by 90 percent or higher in the cold and hot FTP with both fuels; however some aldehyde increases were obtained on the NYCC with both fuels for the same vehicle configuration.

C. Ammonia

Ammonia is a toxic gas found in diesel engine exhaust by the reduction of nitrogen. In this project, ammonia was sampled only during the cold FTP and hot FTP but using all vehicle configurations and both test fuels. The ammonia results are listed in Table 23.

With both test cycles and fuels, ammonia emissions were highest from the naturally-aspirated Fiat having no aftertreatment. The vehicle's ammonia emission rates of 118 mg/km on the cold FTP and 27 mg/km on the hot FTP EM-469-F were substantially larger than those from the other vehicles, none of which exceeded 10 mg/km. No other strong trends were apparent.

TABLE 23. AMMONIA FTP RESULTS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

	Ammonia Emission Rates (mg/km) by Cycle and Fuel			
	Cold FTP		Hot FTP	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	8.3	118	8.1	27
Fiat N.A./trap	3.8	5.4	3.8	1.5
Fiat T.C.	3.7	0.43	4.5	1.5
Fiat T.C./trap	0.70	1.2	3.1	3.1
Cutlass	8.0	9.3	3.2	6.3

D. Phenols

Twelve phenols were measured in this project, namely phenol, salicylaldehyde, m-cresol, p-cresol, p-ethylphenol, 2-isopropylphenol, 2,3-xylenol, 3,5-xylenol, 2,4,6-trimethylphenol, 2-n-propylphenol, 2,3,5-trimethylphenol, and 2,3,5,6-tetramethylphenol. Several phenols were grouped together because they could not be resolved individually with the present G.C procedure. The compounds m-cresol and p-cresol formed one group, and p-ethylphenol, 2-isopropylphenol, 2,3-xylenol, 3,5-xylenol, and 2,4,6-trimethylphenol formed a second group herein designated "Group Five". The individual run summaries for phenols from each vehicle configuration, cycle, and fuel are presented in Appendix I, Tables I-1 through I-10.

At the initiation of this project, both filtered and unfiltered sampling of phenols was conducted to determine which sampling procedure would provide better results. It was believed that filtering the particulate out of the exhaust sample at 190°C (375°F) could help to keep the sample clear of particulate, thereby causing less interferences. The unfiltered sample was also considered because it was thought that the phenols present in the particulate would be extracted in the sampling impinger. However, no clearly defined trend emerged from the study to establish either sampling procedure as providing smaller interferences or greater sensitivity. This conclusion is better illustrated in Table 24 by comparing average "total" phenols calculated from individual phenols results in Tables I-1 and I-2. The phenols were obtained in the filtered and unfiltered sampling modes, using the two test fuels and the naturally-aspirated Fiat without aftertreatment.

TABLE 24. AVERAGE "TOTAL" PHENOL (FILTERED AND UNFILTERED) RESULTS BY TEST CYCLE AND FUEL, FIAT N.A. WITH NO CATALYST

Fuel Code	Filtered Sampling	Composite 4-bag FTP, mg/km	HFET, mg/km	NYCC, mg/km	85 kph, mg/km
EM-329-F	Yes	8.0	2.9	63	2.0
	No	8.3	5.8	63	2.6
EM-469-F	Yes	16.	9.4	68	9.8
	No	13.	10.	64	2.8

Based on Table 24 results, the Project Officer approved the suggestion that the phenol sampling remaining to be completed on the project be conducted only in the filtered mode in order to reduce costly sample preparation and analysis. Therefore, the subsequent discussion on phenols refers to results obtained using filtered sampling only.

All phenols were detected at least once during this study, as seen in Appendix I summaries. However, the phenol compound appearing more consistently and found in largest quantities throughout this study was 2,3,5,6-tetramethylphenol. Also more apparent than most other phenols in the overall tests were "Group Five" and 2,3,5-trimethylphenol. The obvious data scatter found in Appendix I for most phenols made it difficult to discern a clear-cut trend in their concentrations and distribution. However, 2,3,5,6-tetramethylphenol as compared with the two test fuels among the different driving cycles was generally highest on the NYCC, and second highest on the cold FTP.

A summary of average "total" phenol results prepared from individual runs in Appendix I is presented in Table 25. As found with the individual runs, the average "total" phenols also indicated considerable variation overall. Consequently, each vehicle was represented by highest and lowest "total" phenols found in the study in the various driving cycles. The Fiat N.A. vehicle without aftertreatment was the single vehicle showing increased phenols with EM-469-F throughout the five test cycles. Increased phenols were also found with the Cutlass using EM-469-F in the hot FTP, HFET, NYCC, and 85 kph. "Total" phenols were highest on the NYCC using both fuels with the Fiat N.A., Fiat T.C., and Cutlass diesels. Phenols were decreased an average of 73 percent with catalytic trap on the Fiat N.A. diesel on all cycles and fuels, except the cold FTP (EM-469-F), hot FTP (EM-329-F), and 85 kph (EM-329-F). Reduction of phenols with the Fiat T.C./trap configuration was less apparent throughout the cycles, but it still averaged 60 percent on the cold FTP (EM-329-F), hot FTP (EM-329-F), HFET (EM-469-F), and NYCC (both fuels).

TABLE 25. SUMMARY OF AVERAGE "TOTAL" PHENOL (FILTERED) RESULTS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Average "Total" Phenol Emission Rates (mg/km) by Cycle and Fuel									
	Cold FTP		Hot FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	12.	25.	4.9	8.6	2.9	9.4	63.	68.	2.0	9.8
Fiat N.A./ trap	6.6	42.	11.	1.9	0.74	1.6	24.	7.5	14.	2.3
Fiat T.C.	17.	14.	34.	4.9[a]	0.16[a]	7.2	48.	58.	0[a]	3.0
Fiat T.C./ trap	5.6	18.	6.6	13.	23.	6.0	0[a]	37.	7.8[a]	4.3
Cutlass	7.0	6.6	9.7	12.	0.18	11.	24.	65.	0.72	1.5

[a] single value, not averaged

E. Total Cyanide

Total cyanide sampled in this project included hydrogen cyanide and cyanogen. The gases are both flammable and toxic, with the characteristic odor of bitter almonds. The cyanides are formed by the reduction of nitrogen or nitrogen oxides. The total cyanide emission rates determined for the cold FTP and hot FTP cycles are listed in Table 26. Some total cyanide emission rates in Table 26 were at the MDV, but most were above the MDV by at least a factor of three. The Fiat T.C./trap configuration emitted highest total cyanide in the cold FTP with both fuels and in the hot FTP with EM-329-F. Also showing lower but very similar total cyanide emissions was the Fiat N.A./trap vehicle. The lowest total cyanide of the study occurred with the Fiat N.A. configuration on the cold FTP with EM-329-F and on the hot FTP with both fuels. On the cold FTP, total cyanide was slightly higher with EM-469-F than with EM-329-F on all vehicles except the Fiat N.A./trap configuration. Total cyanide differences between fuels

TABLE 26. TOTAL CYANIDE RESULTS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

	Total Cyanide Emission Rates (mg/km) by Cycle and Fuel			
	Cold FTP		Hot FTP	
Vehicle	EM-329-F	EM-469-F	EM-469-F	EM-469-F
Fiat N.A.	0.12	0.56	.0	0.01
Fiat N.A./trap	1.0	0.65	.42	0.44
Fiat T.C.	0.30	0.87	0.21	0.37
Fiat T.C./trap	1.1	1.4	0.47	0.44
Cutlass	0.21	0.32	0.28	0.13

in the hot FTP were not too apparent on most Fiat configurations. Catalytic traps on the Fiat were generally associated with slightly higher total cyanide emissions.

F. Trap-Collected Gaseous Hydrocarbons

Hydrocarbons were collected from filtered, dilute exhaust on traps, and the cyclohexane elutions were analyzed qualitatively by gas chromatograph for boiling range and for paraffin peaks. Trap sampling for hydrocarbons was conducted during the 4-bag FTP, NYCC and 85 kph for each vehicle configuration/fuel combination. A single trap was employed for each test cycle, including one trap for the entire 4-bag FTP.

Summaries of the trap-collected gaseous HC data are given in Tables 27, 28, and 29 for the naturally-aspirated Fiat with and without aftertreatment, the turbocharged Fiat with and without aftertreatment, and the 1981 Oldsmobile Cutlass, respectively. Since it is expected that gaseous HC are closely related to "unburned" fuel, gas chromatograph analysis of the test fuels in similar format is given in Table 30 for comparison. The test fuels were blended in cyclohexane for G.C. analysis. The data in Table 30 show little difference in boiling range between fuels, but most of the fractional distillation points a few degrees higher for EM-469-F.

The HC boiling range of the Fiat N.A. diesel without aftertreatment in Table 27, as compared to the fuel data in Table 30, had a higher heavy end for each cycle and fuel. The average end point temperature of the HC was 463°C, compared to 436°C obtained for the two fuels themselves. Generally, trapped hydrocarbons showed a tendency towards lower boiling temperatures for light end than the fuels themselves, especially in the NYCC.

TABLE 27. SUMMARY OF GAS CHROMATOGRAPH ANALYSIS[a] OF TRAP-COLLECTED GASEOUS HYDROCARBONS, FIAT N.A. DIESEL WITH AND WITHOUT EXHAUST AFTERTREATMENT

Weight % off	Temperature in C° by Cycle and Fuel					
	4-Bag FTP		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
	Without Aftertreatment					
0 (IBP)	157	154	154	152	153	153
5	218	197	156	155	173	156
10	231	208	195	166	196	195
20	247	232	197	197	229	216
40	278	268	230	265	258	275
60	309	305	265	312	296	329
80	364	368	320	382	358	393
90	398	398	368	420	395	420
95	416	416	401	440	418	439
100(EP)	466	453	458	465	472	463
	With Catalytic Trap					
0 (IBP)	153	127	193	127	193	127
5	184	138	215	137	212	133
10	196	166	259	159	254	147
20	230	226	323	257	328	203
40	265	341	371	359	373	348
60	320	385	412	396	412	391
80	395	415	453	419	449	418
90	427	427	475	429	470	428
95	442	432	490	433	483	433
100(EP)	463	437	513	437	506	437

[a] by ASTM D2887-73 simulated distillation

TABLE 28. SUMMARY OF GAS CHROMATOGRAPH ANALYSIS[a] OF TRAP-COLLECTED GASEOUS HYDROCARBONS, FIAT T.C. DIESEL WITH AND WITHOUT EXHAUST AFTERTREATMENT

Weight % off	Temperature in C° by Cycle and Fuel					
	4-bag FTP		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
			Without Aftertreatment			
0 (IBP)	133	133	132	132	132	132
5	138	139	136	135	135	135
10	150	152	140	139	139	140
20	176	178	153	150	154	156
40	229	229	192	181	205	209
60	271	271	245	232	280	275
80	309	309	300	289	352	327
90	346	347	337	320	405	364
95	367	370	367	350	494	403
100(EP)	402	404	504	406	504	502
			With Catalytic Trap			
0 (IBP)	112	112	112	112	112	112
5	121	112	113	114	115	114
10	131	113	116	117	119	116
20	164	116	122	124	128	122
40	204	130	142	148	166	139
60	242	178	181	197	262	171
80	289	250	252	270	376	249
90	326	289	308	322	393	306
95	375	310	348	367	411	345
100(EP)	419	356	414	399	420	392

[a] by ASTM D2887-73 simulated distillation

TABLE 29. SUMMARY OF GAS CHROMATOGRAPH ANALYSIS[a] OF TRAP-COLLECTED GASEOUS HYDROCARBONS, 1981 OLDSMOBILE CUTLASS DIESEL, FUELS EM-329-F AND EM-469-F

Weight % off	Temperature in C° by Cycle and Fuel					
	4-bag FTP		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
0 (IBP)	94	93	92	92	92	93
5	114	99	98	96	97	97
10	140	118	108	102	102	110
20	205	138	137	120	122	141
40	305	194	226	168	179	214
60	471	244	308	212	242	275
80	490	302	491	262	295	320
90	496	339	497	298	323	350
95	499	360	499	313	347	364
100(EP)	500	385	500	348	385	385

[a] by ASTM D2887-73 simulated distillation

TABLE 30. SUMMARY OF GAS CHROMATOGRAPH ANALYSIS[a] OF EM-329-F AND EM-469-F DIESEL FUELS

Weight % Off	Temperature in C° by Fuel	
	EM-329-F	EM-469-F
0 (IBP)	155	153
5	200	204
10	217	224
20	244	251
40	276	280
60	300	305
80	330	345
90	359	368
95	376	386
100(EP)	435	438

[a] by ASTM D2887-73 simulated distillation

Changes in HC boiling range were apparent with catalytic trap use on the naturally-aspirated Fiat as compared to the same vehicle without aftertreatment in Table 27. With the trap and fuel EM-329-F, the boiling range was similar on the FTP, but was shifted higher on the NYCC and 85 kph. Using the catalytic trap, the EM-469-F HC heavy and light end boiling temperatures were shifted lower on all cycles by about 24°C, but the mid-range components showed boiling temperature increases.

A comparison of HC boiling range in Table 28 obtained for the turbocharged Fiat without aftertreatment and the fuel data in Table 30 shows a consistently lower initial boiling point for HC than for fuels. With the gaseous HC, the end point was lower than that of the fuel in the 4-bag FTP with both fuels, and in the NYCC with EM-469-F. Somewhat higher HC end points than fuel end points were noted in the NYCC with EM-329-F, and in the 85 kph with both fuels. Mid-range boiling temperatures were lower for the HC than for the fuel especially in the 4-bag FTP and NYCC, with both fuels.

The use of a catalytic trap on the turbocharged Fiat (Table 28) generally lowered the gaseous HC boiling ranges. The decrease in the initial boiling point for each cycle and fuel was very consistent at 20°C. An increase in the end point was noted for the vehicle with trap in the 4-bag FTP.

The gaseous HC initial boiling point of the Cutlass (Table 29), as compared to fuel boiling range results (Table 30), was lower by about 60°C on each cycle and test fuel. The end point was also approximately 60°C lower for gaseous HC in the FTP and NYCC with EM-469-F, and in the 85 kph with both fuels. The mid-range and heavy-end HC temperatures in the 4-bag FTP and NYCC with fuel EM-329-F were higher than the fuel.

Summaries of the paraffin peaks detected during the boiling range determination of trap-collected gaseous hydrocarbons are provided in Appendix J, Tables J-1 (EM-329-F) and J-2 (EM-469-F). Generally, more paraffin peaks were detected in the 4-bag FTP, which may have been related to sample size, since more dilute exhaust is passed through the traps during this cycle than the other cycles.

Data in Tables J-1 and J-2 indicated that the type and relative amount of paraffin peaks between fuels alone were very similar. The fuels indicated paraffin peaks between C_8 and C_{24} with the strongest peaks concentrated between C_{14} and C_{18}. In the HC study, more paraffin peaks were detected using the Fiat N.A. diesel without aftertreatment, and they were very consistently of the same type found with the two fuels between C_{10} and C_{24}. Compared to fuel results, the relative abundance of C_{16} through C_{18} HC peaks for the Fiat N.A. diesel without aftertreatment was lower with all cycles and fuels. Results for the catalytic trap-equipped Fiat N.A. diesel, compared to the same vehicle without aftertreatment indicated fewer paraffin peaks especially for the 4-bag FTP with EM-469-F and the NYCC and 85 kph with both fuels.

Trapped HC from the Fiat T.C. without aftertreatment showed the same number and type of paraffin peaks as the corresponding fuels between C_{10} and C_{24} on the 4-bag FTP. When the trap was used with fuel EM-469-F, fewer peaks (only C_{12}, C_{14}, and C_{15}) were found.

On the Cutlass, more paraffin peaks were found overall with EM-469-F than with EM-329-F. Idenitcal peaks detected on the 4-bag FTP with both fuels were C_8, C_{12}, C_{15}, C_{18}, and C_{24}. The NYCC with fuel EM-469-F had more peaks than with EM-329-F and they were mostly concentrated in the C_{12} through C_{18} region.

G. Organic Sulfides

Organic sulfides measured in this project were carbonyl sulfide, methyl sulfide, ethyl sulfide, and dimethyl disulfide. The organic sulfides are malodorous compounds, producing odors similar to rotten eggs. Individual test results for organic sulfides as obtained with the five vehicle configurations, two test fuels, and four test cycles (cold FTP, hot FTP, HFET, and NYCC) are provided in Appendix K. A single run at 85 kph, obtained early in the program, is included for comparison in Table K-1.

Dilute exhaust sampling at 125 mℓ/min for organic sulfides, as used at the initiation of this program, collected so much sample in the traps that the FPD detector was saturated. Subsequently, the sampling flowrate was reduced to 41 mℓ/min. Some samples continued to be saturated, but further reduction of sample flow rate would have unnecessarily lengthened the residence time of the sample in the sampling interface. Other sampling configurations were tried, but gave inconsistent data. The Project Officer concurred with the plan that no further procedural development work for organic sulfide sampling take place, and that the sampling rate be maintained at 41 mℓ/min during the remainder of the program.

Individual test results for organic sulfides included in Appendix K indicated that carbonyl sulfide and methyl sulfide were found consistently in the dilute exhaust with all vehicle configurations, fuels, and test cycles. In addition, carbonyl sulfide was generally present in noticeably larger concentrations than methyl sulfide. Ethyl sulfide and dimethyl disulfide were found in low concentrations but only for the Fiat N.A. diesel with and without aftertreatment, using fuel EM-329-F as shown in Tables K-1 and K-3.

A summary of average "total" organic sulfide results prepared using emissions data in Appendix K is presented in Table 31. The highest organic sulfide emissions were those of the Cutlass for all cycles and fuels except in the NYCC with EM-329-F. The Fiat N.A. diesel with and without aftertreatment usually emitted the lowest organic sulfide emissions of the study. On all vehicles and fuels, higher concentrations of organic sulfides were found in the NYCC than in the other driving cycles. Although strong emission trends did not develop between the two test fuels, the Fiat T.C. diesel without aftertreatment did emit lower organic sulfides with EM-469-F than with EM-329-F in all cycles. Organic sulfides were also higher over all cycles

TABLE 31. SUMMARY OF AVERAGE "TOTAL" ORGANIC SULFIDE RESULTS FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Average "Total" Organic Sulfide Emission Rates (mg/km) by Cycle and Fuel							
	Cold FTP		Hot FTP		HFET		NYCC	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	14.[a]	16.	16.[a]	22.	16.	8.9	152.	120.
Fiat N.A./ trap	39.	27.[a]	31.	19.[a]	8.5	14.[a]	172.	93.[a]
Fiat T.C.	32.	20.	33.	28.	22.	13.	160.	111.
Fiat T.C./ trap	16.	39.	23.[a]	23.	13.	18.	130.	178.
Cutlass	44.	81.	34.[a]	56.	25.	27.[a]	163.[a]	196.

[a] Single test only

with the Cutlass using EM-469-F. No emission trends were apparent with catalytic trap use on the Fiat N.A. and T.C. diesels.

H. Hydrogen Sulfide

Hydrogen sulfide was measured during the cold FTP, hot FTP, HFET, and NYCC driving cycles employed in this project. Hydrogen sulfide is a toxic gas with the characteristic odor of rotten eggs, and one of the lowest odor thresholds known.

Although early tests in this project using the naturally-aspirated Fiat without aftertreatment indicated the vehicle emitted hydrogen sulfide, later findings showed that sulfur dioxide was more clearly the pollutant actually detected. Overall, no hydrogen sulfide was found in the dilute exhaust of the five test vehicle configurations employed. The compound, if present in the dilute exhaust, was well below the MDV listed in Table 8 for hydrogen sulfide.

I. Organic Amines

The organic amines are possible reduced nitrogen exhaust products having an offensive fish type odor at low concentrations. The amines may also be intermediates in the formation of nitrosamines, known carcinogens. Organic amines, analyzed for in vehicle raw exhaust during the 85 kph steady-state in this project, included methylamine, ethylamine, dimethylamine, trimethylamine, diethylamine, and triethylamine. Ethylamine and dimethylamine could not be analyzed separately, so that emission rates for these two components are both reported under ethylamine in this discussion.

A summary of organic amines results obtained with the five vehicle configurations and the two test fuels is presented in Table 32.

TABLE 32. SUMMARY OF ORGANIC AMINES RESULTS AT 85 KPH STEADY-STATE WITH FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Organic Amine Measured[a]	Organic Amines Emission Rates in µg/m³ (ppm) Raw Exhaust by Fuel	
		EM-329-F	EM-469-F
Fiat N.A.	Methylamine	9.2 (0.007)[b]	0 (0)
	Ethylamine	19. (0.01)	0 (0)
	Trimethylamine	12. (0.005)	0 (0)
Fiat N.A./ trap	Methylamine	0 (0)	1.5 (0.001)
	Ethylamine	5.2 (0.003)	0 (0)
	Trimethylamine	6.4 (0.003)	6.4 (0.003)
Fiat T.C.	Methylamine	0 (0)	0 (0)
	Ethylamine	0 (0)	0 (0)
	Trimethylamine	0 (0)	0 (0)
Fiat T.C./ trap	Methylamine	21. (0.016)	20. (0.015)
	Ethylamine	107. (0.057)	90. (0.048)
	Trimethylamine	0 (0)	2.8 (0.001)
Cutlass	Methylamine	0 (0)	0 (0)
	Ethylamine	0 (0)	0 (0)
	Trimethylamine	0 (0)	0 (0)

[a] diethylamine and triethylamine sampled for, but were not found in any vehicle

Diethylamine and triethylamine were not detected throughout the study. Organic amines, when detected, were generally found at low concentrations. Qualification of the organic amines procedure, conducted earlier at this laboratory(8), showed that recovery (particularly of methylamine) was quite low when sampling from a dilution tunnel. It is assumed that the raw samples are faced with the same problem, but no attempt was made to correct for losses.

No organic amines were detected with the Fiat N.A. diesel without aftertreatment using EM-469-F, the Fiat T.C. diesel without aftertreatment using either fuel, or the Cutlass using either fuel. The highest concentrations of methylamine and ethylamine found during the study were emitted by the Fiat T.C. with catalytic trap.

J. N-Nitrosamines

Seven N-nitrosamines measured in this project using ThermoSorb/N traps were earlier identified in this report (Section IV, A) as N-nitrosodimethylamine (NDMA), N-nitrosodiethylamine (NDEA), N-nitrosodipropylamine (NDPA) N-nitrosodibutylamine (NDBA), N-nitrosopiperidine (NPIP), N-nitrosopyrrolidine (NPYR), and N-nitrosomorpholine (NMOR). The N-nitrosamines were sampled over a test sequence consisting of a 4-bag FTP, HFET, NYCC, and 85 kph. In order to enhance the detection of the N-nitrosamines in the dilute exhaust of the various test vehicles, one ThermoSorb/N trap was used during an entire test sequence employed with each vehicle configuration and fuel combination as follows:

Test Vehicle	Fuel Code	ThermoSorb/N Trap Code
Fiat N.A.	EM-329-F	17700
	EM-469-F	17701
Fiat N.A./trap	EM-329-F	17703
	EM-469-F	17692
Cutlass	EM-329-F	17693
	EM-469-F	17694
Fiat T.C.	EM-329-F	17695
	EM-469-F	17696
Fiat T.C./trap	EM-329-F	17698
	EM-469-F	11824

All ThermoSorb/N Traps used in this project were analyzed by the Thermo Electron Corporation in Waltham, Massachusetts employing either GC-TEA or HPLC-TEA instrumental analysis, as each sample required. Each trap sample was first analyzed with GC-TEA; and if sample interferences occurred, those samples were again analyzed with HPLC-TEA. Interferences were noted in all samples, except those obtained using the turbocharged Fiat without aftertreatment. A detailed list noting sample preparation and instrument condition used is presented in Appendix L.

No N-nitrosamines were detected in the ten trap samples previously described in this section. Formal reports prepared by Thermo Electron Corporation on the various trap analyses are provided in Appendix L, and include the lower limits of detection for the N-nitrosamines employing the GC-TEA and HPLC-TEA analytical procedures. The average MDV for N-nitrosamines using GC-TEA was 0.90 µg/km, and that with HPLC-TEA was 4.4 µg/km.

VIII. UNREGULATED PARTICULATE EMISSIONS RESULTS

The discussion of the unregulated particulate emissions results is included in this section. Specific topics considered individually include visible smoke emissions, particle size distribution, particulate composition, sulfate, trace elements, percent organic solubles, organic solubles composition, organic solubles boiling range, organic solubles polarity profile, benzo(a)pyrene in organic solubles, and mutagenic activity of organic solubles. Where possible, individual run data are grouped, averaged, and tabulated.

A. Visible Smoke Emissions

Visible smoke emissions were measured over the first 505 seconds of the FTP using an EPA smokemeter. The smoke opacity and vehicle speed were simultaneously recorded using a 2-pen strip chart recorder. The recorder traces were analyzed manually, and are provided in Appendix M, Pages M-2 through M-11. The results are summarized in Table 33.

Although no strong fuel trends emerged in the smoke data, the Fiat N.A. diesel with and without aftertreatment did produce slightly lower smoke with EM-469-F. The cold start peak and cold idle smoke were highest for the Fiat T.C. diesel without aftertreatment on both fuels. Highest smoke on the 1st accel peak was emitted by the Fiat T.C. diesel without aftertreatment on EM-329-F and by the Cutlass with EM-469-F. Overall, the lowest and highest smoke emitters using both fuels at the conditions of Table 33, were the Fiat N.A. diesel with catalytic trap and the Fiat T.C. diesel without aftertreatment, respectively. The use of catalytic trap on the naturally-aspirated and turbocharged Fiats generally reduced visible smoke emissions with both test fuels.

TABLE 33. VISIBLE SMOKE DATA FOR FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Condition	Smoke, PHS % by Vehicle and Fuel									
	Fiat N.A.		Fiat N.A./Trap		Fiat T.C.		Fiat T.C./Trap		Cutlass	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Cold start peak	55.5	38.0	18.0	13.0	69.0	82.7	18.0	34.2	3.2	4.5
Cold Idle (after start)	1.0	1.0	1.0	0.3	25.0	40.0	22.0	20.0	1.5	1.5
1st accel. peak	17.5	23.0	5.5	3.8	46.2	33.0	1.7[a]	0.7	21.5	44.5
Idle @ 125 sec	1.0[a]	1.0	1.0	0.2	0.6	0.6	0.2[a]	0.5	5.4	4.5
Accel, peak @ 164 sec.	13.5[a]	7.0	5.0	3.5	12.0	18.2	4.7[a]	2.8	18.0	17.0

B. Particle Size Distribution

Aerodynamic sizing of the particulate matter, performed during the 4-bag FTP with the five vehicle configurations and two fuels, was accomplished using a Sierra Model 220 cascade impactor. The precision of particle sizing by the impactor may have been decreased by the occasional sticking of the back-up filter to its o-ring seal, and by difficulty in weighing some very small net weight gains on individual impactor stages. One reason for using the impactor during an entire 4-bag FTP was to enhance the particulate collection on each stage enabling more precise weight determinations.

Particle size determinations for the 4-bag FTP with each vehicle configuration are presented in Figures 15 and 16 for EM-329-F and EM-469-F, respectively. The least change in particle diameter between fuels was observed with the Cutlass. Catalytic trap use generally increased particle size on the Fiat N.A. diesel with both fuels, and on the Fiat T.C diesel with EM-469-F. With fuel EM-329-F, particle size was mostly decreased when the trap was used on the turbocharged Fiat. One might anticipate that as the sulfate content of particulate is increased, particle size would decrease. The opposite effect was observed, however, since the FTP sulfate studies with EM-329-F (in Section VIII, D of this report) indicated a higher fraction of sulfate in particulate with the Fiat N.A./trap configuration and a lower fraction of sulfate in particulate with the Fial T.C./trap configuration. Therefore, the particle size shifts with the trap-equipped Fiats may depend more strongly on the different physical and operating parameters of the vehicles.

A summary of the carbon, hydrogen, and nitrogen content of the particulate matter collected on 47 mm glass fiber filters is presented in Table 34.

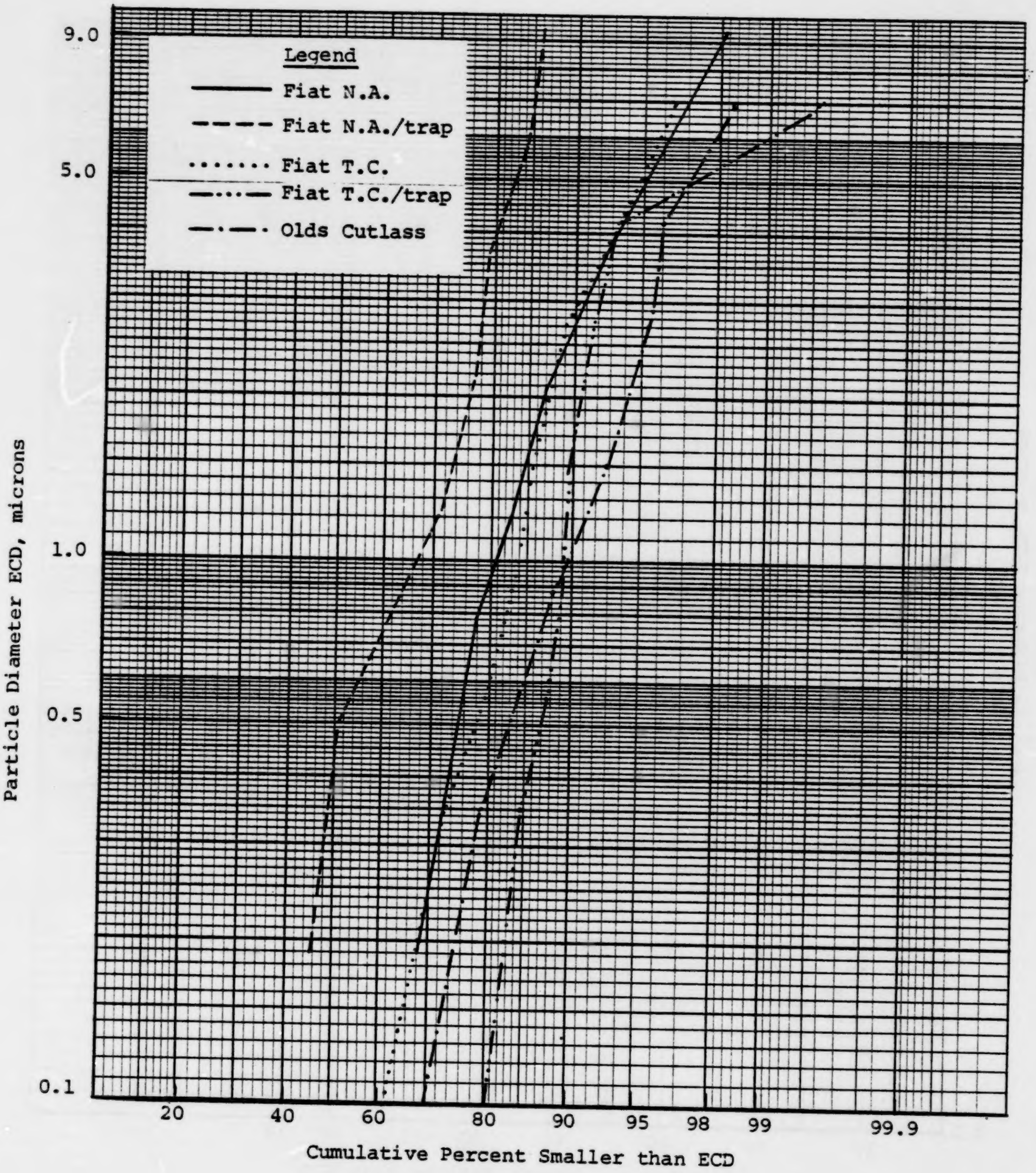

Figure 15. Cumulative particle size distributions by impactor with Fiat N.A., Fiat T.C., and 1981 Oldsmobile diesels, Fuel EM-329-F

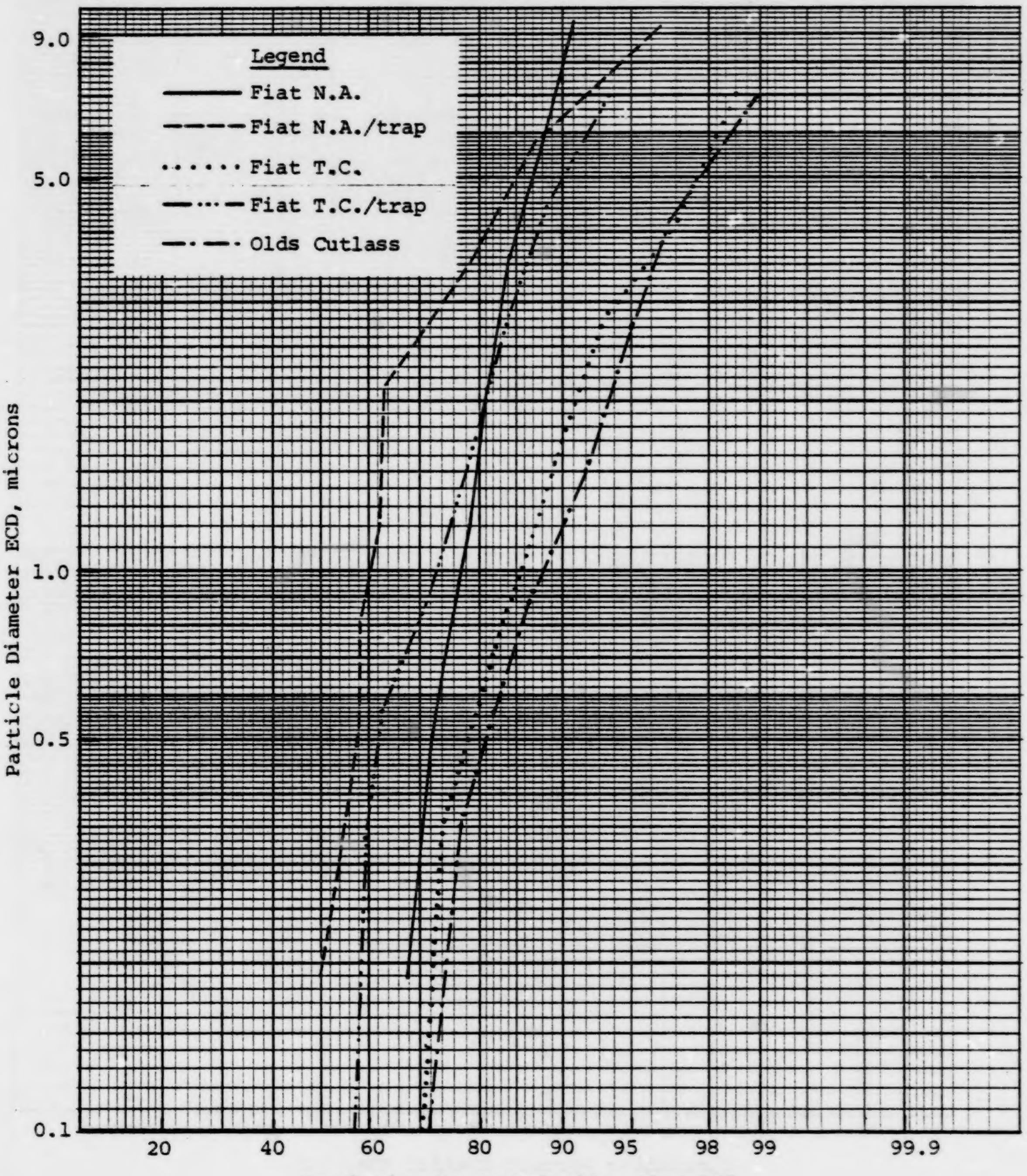

Figure 16. Cumulative particle size distributions by impactor with Fiat N.A., Fiat T.C., and 1981 Oldsmobile diesels, Fuel EM-469-F

TABLE 34. CARBON, HYDROGEN, AND NITROGEN IN EXHAUST PARTICULATE MATTER FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Test Cycle	Weight Percent of Particulate by Element and Fuel							
		Carbon		Hydrogen		Nitrogen		Σ CHN	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	4-bag FTP	78.73	75.61	7.12	7.03	0.65	0.60	86.50	83.24
	HFET	78.32	79.70	9.14	8.75	0.38	0.49	87.84	88.94
	NYCC[a]	70.00	64.49	6.10	5.78	1.00	0.87	77.10	71.14
	85 kph	81.36	81.43	8.96	9.14	0.39	0.34	90.71	90.91
Fiat N.A./trap	4-bag FTP[c]	71.24	83.75	3.86	4.59	0.64	0.97	75.74	89.31
	HFET[c]	36.14	36.93	3.45	4.44	0.62	0.61	40.21	41.98
	NYCC[a]	45.44	68.12	4.57	9.97	1.12	1.13	51.13	79.22
	85 kph	23.35	29.89	2.06	3.31	0.49	0.95	25.90	34.15
Fiat T.C.	4-bag FTP	66.31	69.08	5.16	5.43	0.54	0.55	72.01	75.06
	HFET	57.56	58.78	2.95	3.51	0.38	0.43	60.89	62.72
	NYCC[a]	41.98	40.80	2.04	2.87	0.37	0.36	44.39	44.03
	85 kph	63.62	64.56	2.58	3.70	0.59	0.48	66.79	68.74
Fiat T.C./trap	4-bag FTP[a]	90.23	87.06	6.91	6.97	0.85	0.75	97.99	94.78
	HFET[a]	50.64	27.51	8.63	5.64	0.50	0.16	59.77	33.31
	NYCC[a]	23.03	8.91	11.93	12.86	0.29	<0.1	35.25	<21.87
	85 kph[b]	49.19	32.44	6.05	4.90	0.53	0.29	55.77	37.63
Cutlass	4-bag FTP	85.60	79.02	1.88	1.66	0.44	0.28	87.92	80.96
	HFET	68.48	76.19	2.24	2.25	0.39	0.26	71.11	78.70
	NYCC[a]	63.38	70.95	1.69	0.86	0.38	0.34	64.45	72.15
	85 kph	72.62	73.07	2.86	2.93	0.52	0.49	76.00	76.49

[a] less than 2 mg total particulate on filter with EM-329-F and EM-469-F
[b] less than 2 mg total particulate on filter with EM-329-F
[c] less than 2 mg total particulate on filter with EM-469-F

The elemental data for the five vehicle configurations generally showed a low hydrogen content, indicative of a dry or soot-like particulate material rather than an oily material. The carbon content varied somewhat, but most cases of low carbon content (such as found in the NYCC) may have been more indicative of decreased precision in the analytical method. All samples in the NYCC contained less than 2 mg particulate/filter, and the particulate content was least on the trap-equipped Fiats. Significant elemental content differences between the two fuels were usually not apparent, especially for hydrogen and nitrogen. Carbon content for the trap-equipped Fiats was decreased in the HFET and 85 kph, as was hydrogen content with the trap-equipped naturally-aspirated Fiat. Hydrogen increased in the turbocharged Fiat with catalytic trap in the HFET and 85 kph. Part of the particulate matter unaccounted for by the sum of carbon, hydrogen, and nitrogen in the HFET and 85 kph with the trap-equipped Fiats may have been sulfate ($SO_4^=$). Sulfate studies with EM-329-F as discussed in Section D below, indicated a higher fraction of sulfate in particulate for the Fiats with catalytic trap in the HFET and 85 kph.

D. Sulfate

Sulfate is a toxic substance when in the form of sulfuric acid, and it results from the catalytic oxidation of sulfur dioxide to sulfur trioxide. Sulfur trioxide, in turn, is hydrated to sulfuric acid. The sampling of sulfate on this project was performed on all Fiat configurations during the 4-bag FTP, HFET, NYCC, and 85 kph with fuel EM-329-F only. Sulfate results are summaried in Table 35.

TABLE 35. SULFATE RESULTS FOR FIAT N.A. AND FIAT T.C. DIESELS WITH FUEL EM-329-F

Vehicle	Measurement	Sulfate Emissions by Cycle			
		4-bag FTP	HFET	NYCC	85 kph
Fiat N.A.	$SO_4^=$, mg/km	3.1	0.69	3.8	0.65
	$SO_4^=$, % of Part.	1.4	0.37	1.3	0.43
	% Fuel S in $SO_4^=$	0.60	0.18	0.43	0.17
Fiat N.A./trap	$SO_4^=$, mg/km	1.6	7.7	6.5	18.
	$SO_4^=$, % of Part.	2.4	18.	4.9	29.
	% Fuel S in $SO_4^=$	0.32	2.1	0.86	5.0
Fiat T.C.	$SO_4^=$, mg/km	8.7	7.8	9.0	6.5
	$SO_4^=$, % of Part.	5.2	8.8	3.9	8.4
	% Fuel S in $SO_4^=$	1.4	2.0	0.92	1.7
Fiat T.C./trap	$SO_4^=$, mg/km	1.7	3.3	2.3	5.9
	$SO_4^=$, % of Part.	2.9	9.4	2.8	15.
	% Fuel S in $SO_4^=$	0.28	0.88	0.24	1.6

On both Fiats, sulfate emission rates for the HFET and 85 kph, as compared to those for the 4-bag FTP and NYCC, were lowest without aftertreatment and highest with trap configuration. The highest sulfate rates of the study were emitted by the Fiat naturally-aspirated diesel with catalytic trap during the 85 kph, and by the Fiat turbocharged diesel without aftertreatment during the 4-bag FTP, HFET, and NYCC. The catalytic trap reduced sulfate emission rates on the 4-bag FTP with the Fiat N.A. diesel, and on all cycles with the Fiat T.C. diesel. Sulfate, measured as percent of particulate, increased with the trap on the Fiat N.A. diesel during all cycles, and on the Fiat T.C. diesel during the HFET and 85 kph. The largest increases in sulfate, as percent of particulate, occurred on the HFET and NYCC with the trap-equipped naturally-aspirated Fiat.

E. Trace Elements

Sampling of particulate matter for analyses of trace elements was conducted during the 4-bag FTP, HFET, NYCC, and 85 kph using the five vehicle configurations and two test fuels. One 47 mm Fluoropore filter was used to collect particulate during each test cycle, including the use of a single filter for the entire 4-bag FTP. The emission rates of thirty-one metals and other elements were determined in this project. The metals and other elements measured included sodium, sulfur, vanadium, nickel, cadmium, mercury, magnesium, chlorine, chromium, copper, tin, lead, aluminum, potassium, manganese, zinc, antimony, silicon, calcium, iron, selenium, barium, phosphorus, titanium, bromine, platinum, strontium, molybdenum, tungsten, arsenic, and cobalt.

Results of the elemental analyses conducted on particulate matter from each vehicle configuration with two test fuels are presented in Appendix N. Emission rates below 0.01 mg/km were not reported for elements studied in this project.

Nickel, mercury, platinum, arsenic, and cobalt were the only elements not detected at 0.01 mg/km or above. Fourteen elements detected at emission rates as high as 1.0 mg/km were sodium, sulfur, chromium, aluminum, manganese, lead, zinc, silicon, selenium, calcium, iron, phosphorus, bromine, and molybdenum. Only sulfur and iron were emitted at or above 1.0 mg/km, with emissions not exceeding 3.62 mg/km for sulfur and 1.07 mg/km for iron. Over the four cycles and two fuels, the elements detected made up from 1.3% to 2.1% of particulate rate for the naturally-aspirated Fiat without aftertreatment, 3.1% to 11.8% for the naturally-aspirated Fiat with catalytic trap, 1.2% to 1.7% for the Cutlass, 1.3% to 3.0 % for the turbocharged Fiat without aftertreatment, and 1.8% to 9.5% for the turbocharged Fiat with catalytic trap.

Trace elements found most commonly in particulate matter were sulfur, magnesium, aluminum, zinc, silicon, calcuim, iron, barium, and phosphorus. Most of the sulfur emitted was likely derived from fuel sulfur, while possible sources of magnesium, aluminum, and iron include wear products from the engines and corrosion products from the exhaust systems. Zinc, calcium, barium, and phosphorus are possibly derived from lubricating oil. Over the four cycles and two fuels, more different types of trace elements were emitted by the two Fiat N.A. configurations and by the Cutlass, than by the two Fiat T.C. configurations.

Sulfur and iron generally accounted for more than fifty percent of the "total" trace element emission rate in each cycle. Iron emission rates were regularly higher in the 4-bag FTP and NYCC than in the HFET and 85 kph with each vehicle configuration and test fuel. Higher sulfur was regularly emitted on the 4-bag FTP and NYCC than in the HFET and 85 kph using the Fiats without aftertreatment and both fuels. The reverse trend in sulfur emissions was noted for the trap configurations of the Fiats, that is, decreased sulfur emissions were emitted on the 4-bag FTP and NYCC, and increased sulfur emissions were emitted for the HFET and 85 kph. These sulfur emission trends with cycle type closely paralleled those of sulfate observed with the respective Fiat configurations as discussed earlier in this report.

F. Percent Organic Solubles

Organic solubles were extracted from particulate collected on 500x500 mm filters during the 23-minute cold FTP, 23-minute hot FTP, HFET, NYCC, and 85 kph. The organic solubles obtained were used in the analyses of percent organic solubles, major elements (C, H, and N), G.C. boiling range, HPLC polarity profile, BaP, and mutagenic activity by Ames bioassay. Solubles for use on all analyses except BaP were extracted with methylene chloride. All solubles for BaP analyses were initially extracted with benzene/ethanol and were then re-extracted with hexane/methylene chloride according to the procedures of Section IV, A, 16 of this report. The discussion in this section is restricted to the results obtained for percent organic solubles, while discussions on the other solubles analyses will follow in later sections of this report. Representative data on the percent organic solubles extracted are found in Table 36 for methylene chloride, and in Table 37 for benzene/ethanol.

The use of catalytic trap on both Fiats as discussed earlier in Section VI, effectively reduced particulate emissions on most cycles with both fuels. Consequently, a substantial number of additional cold FTP, hot FTP, HFET, NYCC, and 85 kph tests had to be run using the catalytic trap-equipped Fiats with both fuels to collect sufficient particulate for extraction of organic solubles. Employing the multiple testing ultimately provided enough organic solubles to meet all the sample needs for analyses of HPLC polarity profile and Ames bioassay, plus some of the more important sample needs for analyses of major elements and G.C. boiling range. Additional tests beyond those shown in Table 37 to collect organic solubles for BAP analyses were not required.

TABLE 36. METHYLENE CHLORIDE SOLUBLES OF PARTICULATE SAMPLES FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Measurement	Organic Solubles Data by Cycle and Fuel									
		Cold FTP		Hot FTP		HFET		NYCC		85 kph	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	Total Part. g	0.6464	0.5662	0.6534	0.5383	0.6756	0.5821	0.1170	0.1282	0.8935	0.8521
	CH_2Cl_2 Solubles, g	0.3404	0.2824	0.3721	0.3221	0.4500	0.3759	0.0464	0.0732	0.5726	0.5711
	Percent Solubles	52.7	49.9	56.9	59.8	66.6	64.6	39.7	57.1	64.1	67.0
Fiat N.A./ trap	Total Part. g	0.8516[a]	0.6822[a]	0.6631[a]	0.5718[a]	0.7810[a]	0.3299[a]	0.3036[a]	0.3843[a]	2.0212[a]	0.7340[a]
	CH_2Cl_2 Solubles, g	0.1036	0.0715	0.0780	0.0749	0.0402	0.0336	0.0276	0.0343	0.0411	0.0331
	Percent Solubles	12.2	10.5	11.8	13.1	5.1	10.2	9.1	8.9	2.0	4.5
Fiat T.C.	Total Part. g	0.4525	0.6209	0.3505	0.4230	0.2899	0.3099	0.1105	0.1290	0.4514	0.4395
	CH_2Cl_2 Solubles, g	0.1448	0.2522	0.1442	0.1907	0.0798	0.1002	0.0458	0.0457	0.0939	0.1156
	Percent Solubles	32.0	40.6	41.1	45.1	27.5	32.3	41.4	35.4	20.8	26.3
Fiat T.C./ trap	Total Part. g	0.1775[b]	0.1595[c]	0.1205[b]	0.1208[c]	0.6446[a]	0.7053[a]	0.6766[a]	0.3956[a]	4.4841[a]	3.7903[a]
	CH_2Cl_2 Solubles, g	0.0233	0.0233	0.0241	0.0083	0.0620	0.0453	0.1159	0.1598	0.0626	0.1072
	Percent Solubles	13.1	14.6	20.0	6.9	9.6	6.4	17.1	40.4	1.4	2.8
Cutlass	Total Part. g	0.7805	0.7876	0.5628	0.5418	0.5211	0.4917	0.1667	0.7070[a]	0.6489	0.5809
	CH_2Cl_2 Solubles, g	0.0774	0.0883	0.0762	0.0837	0.0827	0.0937	0.0248	0.1062	0.1176	0.1286
	Percent Solubles	9.9	11.2	13.5	15.4	15.9	19.1	14.9	15.0	18.1	22.1

[a] multiple tests run to obtain sufficient particulate for use in required analyses

[b] additional cold and hot FTP's run and combined to collect a total of 1.7598 g particulate with 16.5% solubles

[c] additional cold and hot FTP's run and combined to collect a total of 1.8072 g particulate with 23.0% solubles

TABLE 37. BENZENE-ETHANOL SOLUBLES OF PARTICULATE SAMPLES FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Measurement	Organic Solubles Data by Cycle and Fuel									
		Cold FTP		Hot FTP		HFET		NYCC		85 kph	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	Total Part. g	0.6770	0.5104	0.5909	0.5163	0.6500	0.5573	0.1166	0.1411	0.8897	1.0112
	C_6H_6-ETOH Sol. g	0.3177	0.2258	0.3699	0.3528	0.4493	0.3876	0.0613	0.0759	0.6941	--[a]
	Percent Solubles	46.9	44.2	62.6	68.3	69.1	69.5	52.6	53.8	78.0	--[a]
Fiat N.A./ trap	Total Part. g	0.1915	0.1906	0.2387	0.0814	0.2686	0.1191	0.2244	0.0413	0.6199	0.2925
	C_6H_6-ETOH Sol. g	0.0269	0.0225	0.0228	0.0148	0.0972	0.0300	0.0178	0.0072	0.2825	0.1010
	Percent Solubles	14.0	20.5	9.6	18.2	36.2	25.2	7.9	17.4	45.6	34.5
Fiat T.C.	Total Part. g	0.5348	0.5800	0.3799	0.3909	0.3173	0.3096	0.1127	0.1255	0.4598	0.4460
	C_6H_6-ETOH Sol. g	0.1884	0.3331	0.1617	0.2187	0.1049	0.0995	0.0478	--[a]	0.1185	0.1423
	Percent Solubles	35.2	57.4	42.6	55.9	33.1	32.1	42.4	--[a]	25.8	31.9
Fiat T.C./ trap	Total Part. g	0.1587	0.1614	0.1177	0.1194	0.1032	0.1339	0.0331	0.0304	0.1989	0.2650
	C_6H_6-ETOH Sol. g	0.0323	0.0301	0.0258	0.0342	0.0186	0.0407	0.0072	0.0140	0.0377	0.0815
	Percent Solubles	20.4	18.6	21.9	28.6	18.0	30.4	21.8	46.1	19.0	30.8
Cutlass	Total Part. g	0.7229	0.7555	0.5380	0.5550	0.4899	0.5036	0.1558	0.1595	0.6377	0.5820
	C_6H_6-ETOH Sol. g	0.1039	0.1044	0.0913	0.0973	0.1297	0.1129	0.0256	0.0346	0.1753	0.1432
	Percent Solubles	14.4	13.8	17.0	17.5	26.5	22.4	16.4	21.7	27.5	24.6

[a] data not acceptable

In Table 36, solubles data show that the catalytic trap clearly reduced the organic solubles content in particulate obtained with both Fiats on the five cycles and two fuels, but most noticeably on the 85 kph. The vehicles associated with highest percent of organic solubles in the overall methylene chloride study were the two Fiats without aftertreatment. The Fiat vehicles with catalytic trap gave the lowest percent of organic solubles at 85 kph with both fuels. No clearly defined trends for quantity of organic solubles with fuel type were apparent in the methylene chloride data.

A comparison of the range of percent organic solubles extracted using methylene chloride (Table 36) and benzene/ethanol (Table 37) with the five vehicle configurations is provided below.

Vehicle	Range of Percent Solubles by Solvent Methylene Chloride	 Benzene/Ethanol
Fiat N.A.	39.7 - 67.0	44.2 - 78.0
Fiat N.A./trap	2.0 - 13.1	7.9 - 45.6
Fiat T.C.	20.8 - 45.1	25.8 - 57.4
Fiat T.C./trap	1.4 - 40.4	18.0 - 46.1
Cutlass	9.9 - 22.1	16.4 - 27.5

As found with methylene chloride, the benzene/ethanol extracts were also highest using both Fiats without aftertreatment. Moreover, the catalytic trap similarly served to reduce benzene/ethanol solubles in both Fiats. Compared to methylene chloride data, the benzene/ethanol solubles were higher for each vehicle configuration, but more significantly on the trap-equipped Fiats. This finding may indicate, especially for the trap-equipped Fiats, that a further quantity of polar compounds not extracted with methylene chloride were more efficiently extracted with benzene/ethanol.

G. Organic Solubles Composition

Separate samples of organic solubles from the 4-bag FTP, HFET, NYCC, and 85 kph, run with each vehicle configuration and each test fuel, were analyzed for carbon, hydrogen, and nitrogen. Organic solubles from the cold FTP and hot FTP were combined to provide a 4-bag FTP sample prior to elemental analyses. The results are given in Table 38, and indicate that sufficient organic solubles were not available for overall cycle analyses using the naturally-aspirated and turbocharged Fiats with catalytic traps.

All of the elemental data are indicative of hydrocarbon-like materials with numeric H/C ratio between 1.58 and 1.95. The catalytic trap-equipped Fiats, and especially the turbocharged Fiat, were associated with the lowest H/C ratio for the 4-bag FTP. This result may be indicative of higher content of unsaturated hydrocarbons present for the Fiats using catalytic traps. Also noted with the same Fiats using the catalytic traps were higher nitrogen content and lower sums of the carbon, hydrogen, and nitrogen content (Σ CHN). The lower Σ CHN may be indicative of catalytic action on hydrocarbons, possibly resulting in more oxygenated products.

H. Organic Solubles Boiling Range

The organic soluble material obtained during the cold FTP, hot FTP, HFET, NYCC, and 85 kph using the five vehicle configurations and two fuels was submitted for boiling range determination by gas chromatography. Each sample aliquot, provided according to vehicle, cycle, and fuel combination, was redissolved in methylene chloride prior to analysis (original extraction

TABLE 38. CARBON, HYDROGEN, AND NITROGEN IN EXHAUST PARTICULATE ORGANIC SOLUBLES FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

		Weight Percent of Organic Solubles by Element and Fuel							
		Carbon		Hydrogen		Nitrogen		Σ CHN	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	4-bag FTP	84.74	83.90	12.51	12.67	0.11	0.13	97.36	96.70
	HFET	85.14	78.94	13.12	12.08	0.10	0.08	98.36	91.10
	NYCC	85.13	85.03	13.02	12.95	0.25	0.12	98.40	98.10
	85 kph	84.75	83.88	13.17	12.82	0.05	0.05	97.97	96.75
Fiat N.A./trap	4-bag FTP	83.05	77.96	12.69	11.22	0.49	0.42	96.23	89.60
	HFET	--[a]	--	--	--	0.48	0.50	--	--
	NYCC	--	--	--	--	--	--	--	--
	85 kph	--	--	--	--	0.41	0.41	--	--
Fiat T.C.	4-bag FTP	85.29	85.48	13.28	13.19	0.24	0.22	98.81	98.89
	HFET	85.36	85.25	13.34	13.31	0.16	0.19	98.86	98.75
	NYCC	85.17	85.18	13.35	13.08	0.48	0.29	99.00	98.55
	85 kph	85.25	85.34	13.41	13.06	0.16	0.16	98.82	98.56
Fiat T.C./trap	4-bag FTP	71.78	76.63	9.51	10.50	0.49	0.43	81.78	87.56
	HFET	--	--	--	--	--	--	--	--
	NYCC	--	--	--	--	--	0.92	--	--
	85 kph	--	--	--	--	--	0.27	--	--
Cutlass	4-bag FTP	84.33	84.32	12.58	12.51	0.29	0.30	97.20	97.13
	HFET	84.19	84.91	13.78	13.05	0.28	0.43	98.25	98.39
	NYCC	79.64	84.69	11.61	12.76	0.68	0.39	91.93	97.84
	85 kph	84.99	84.27	13.12	13.21	0.19	0.24	98.30	97.72

[a] organic solubles not available for analysis

was also in methylene chloride. The cold FTP and hot FTP solubles were combined to provide a composite 4-bag FTP sample for analysis. A number of blanks and standards were also run to provide background and calibration information.

The modified ASTM D2887-73 simulated distillation procedure with gas chromatograph has been successfully used in this laboratory to determine the boiling range distribution of lubricants and middle-distillate fuels.(5,6) The same procedure as applied to organic solubles has not been adequately qualified. Therefore, using the procedure to analyze organic solubles has at times resulted in unacceptable data based on what appears to be polymerization of samples during storage or even sample chemistry alteration during actual G.C. analytical runs. Polymerization apparently limits sample solubility. To minimize possible sample storage polymerization during this program, steps were taken to run samples as soon as possible after preparation or to store them at low temperature while awaiting analysis. In spite of these precautions taken, some samples analyzed for boiling range determination showed possible evidence of sample alteration.

Boiling range data obtained were tabulated according to each vehicle configuration, four test cycles, and two test fuels. Results on the Fiat N.A. diesel without aftertreatment and with catalytic trap are found in Appendix O, Tables O-1 and O-2, respectively. Tables O-1 and O-2 are provided for information only since very low recovery of the soluble material with the gas chromatograph was observed on the Fiat N.A. diesel without aftertreatment, thus generally obviating comparison of its solubles boiling range results with those of the same vehicle using the trap catalyst. Boiling range results of solubles from the Fiat T.C. diesel without aftertreatment, Fiat T.C. diesel with catalytic trap, and Cutlass are provided in Tables 39, 40, and 41, respectively. Chromatograms given in Appendix O, Figures O-1 through O-3, respectively include an "Altamont" crude oil standard, a 4-bag FTP solubles sample from the Fiat T.C. diesel without aftertreatment, and a 4-bag FTP solubles sample from the Fiat T.C. diesel with catalytic trap. The turbocharged Fiat solubles used for the chromatograms were obtained with EM-329-F and include a C_9-C_{11} paraffin composite internal standard. Included in Appendix O as Figure O-4 is a chromatogram of fuel EM-329-F obtained with the ASTM D2887-73 procedure programmed from 0°C to 390°C. Each chromatogram in Appendix O was referenced to C_{10} through C_{28} paraffin peaks for ease of comparison.

The recovery of soluble material by the chromatograph procedure ranged from 75.4% to 109.8% for the Fiat T.C. vehicle without aftertreatment, 48.1% to 70.9 % for the Fiat T.C. vehicle with catalytic trap, and 76.7% to 99.4% for the Cutlass. Previous studies(5) indicated that the recovery of the material ranged between 60 and 90 percent.

The boiling temperature of the light-end regions as compared between the turbocharged Fiat without aftertreatment and the Cutlass were more similar in the HFET, NYCC, and 85 kph than in the 4-bag FTP. The 4-bag FTP light-ends of the Cutlass boiled at lower temperatures than those of the turbocharged Fiat without catalytic trap. Major or consistent differences of boiling range with fuel type were not observed. The limited boiling range results obtained with the Fiat T.C. diesel with catalytic trap did not provide a strong basis for comparison with boiling range results of the same vehicle without aftertreatment. The trap-equipped Fiat T.C. diesel, however,

TABLE 39. GAS CHROMATOGRAPH ANALYSIS[a] OF ORGANIC SOLUBLES IN PARTICULATE MATTER, FIAT T.C. DIESEL, NO AFTERTREATMENT, FUELS EM-329-F AND EM-469-F

Distillation Point	Temperature in C° by Cycle and Fuel							
	4-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
IBP	310	264	256	242	227	256	236	263
10% point	374	364	377	372	335	346	369	375
20% point	395	387	400	395	360	363	391	395
30% point	416	411	422	416	377	380	410	413
40% point	440	438	446	437	395	401	429	432
50% point	466	467	472	459	417	429	452	453
60% point	496	502	497	480	446	464	477	476
70% point	546	564	532	502	476	507	506	504
80% point	--	--	595	534	509	574	550	552
90% point	--	--	--	592	552	--	608	640
EP	--	--	--	--	594	--	--	--
Recovery, %	76.9	75.4	84.6	94.8	109.8	88.7	94.4	89.9
@ Temperature, °C	640	640	640	640	595	640	640	640

[a] by modified ASTM D2887-73 simulated distillation

TABLE 40. GAS CHROMATOGRAPH ANALYSIS[a] OF ORGANIC SOLUBLES IN PARTICULATE MATTER, FIAT T.C. DIESEL WITH CATALYTIC TRAP, FUELS EM-329-F AND EM-469-F

Distillation Point	Temperature in C° by Cycle and Fuel							
	4-bag FTP		HFET[b]		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F[b]	EM-469-F	EM-329-F[b]	EM-469-F
IBP	292	303				292		296
10% point	374	371				349		403
20% point	403	394				366		436
30% point	434	439				384		470
40% point	476	467				406		511
50% point	524	506				437		--
60% point	--	--				486		--
70% point	--	--				557		--
80% point	--	--				--		--
90% point	--	--				--		--
EP	--	--				--		--
Recovery, %	58.4	68.6				70.9		48.1
@ Temperature, °C	562	562				562		562

[a] by modified ASTM D2887-73 simulated distillation

[b] insufficient sample for analysis

TABLE 41. GAS CHROMATOGRAPH ANALYSIS[a] OF ORGANIC SOLUBLES IN PARTICULATE MATTER, 1981 OLDSMOBILE CUTLASS DIESEL, FUELS EM-329-F AND EM-469-F

Distillation Point	Temperature in C° by Cycle and Fuel							
	4-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
IBP	250	240	267	249	240	251	247	268
10% point	352	348	364	366	346	344	369	368
20% point	372	366	384	386	365	359	390	387
30% point	394	384	403	405	386	372	408	403
40% point	420	407	424	426	419	388	424	420
50% point	460	440	453	456	472	414	445	442
60% point	512	484	492	497	523	455	472	472
70% point	586	536	547	554	585	502	505	510
80% point	--	600	639	--	--	548	550	573
90% point	--	--	--	--	--	591	607	--
EP	--	--	--	--	--	640	--	--
Recovery, %	76.7	87.2	80.1	78.8	78.2	99.4	95.4	87.1
@ Temperature, °C	640	640	640	640	640	640	640	640

[a] by modified ASTM D2887-73 simulated distillation

did show somewhat higher boiling temperatures for the light-ends using fuel EM-469-F on the 4-bag FTP and 85 kph. The boiling ranges of the fuels, on the average, extended from 154°C to 436°C. Consequently, test results with both configurations of the Fiat T.C. diesel and also the Cutlass indicated an overall upward shift in solubles boiling range as compared to the boiling range of the fuels.

I. Organic Solubles Polarity Profile

Organic soluble samples extracted from particulate with methylene chloride were studied to determine their polarity profile (fractionation by relative polarity). A solubles sample from each vehicle, cycle, and fuel combination was analyzed using HPLC as described earlier in this report. Composite 4-bag FTP samples were prepared for analysis using the cold FTP and hot FTP samples in combination. Background and calibration information was obtained using a number of solvents and standards specific to the HPLC procedure.

The complexity of organic solubles composition makes their chromatographic separation into individual compounds very difficult. The principal use of HPLC enables the separation of the organic solubles into a series of fractions of increasing molecular polarity. The HPLC procedure as employed in this study was only qualitative, mainly because of the differing response factors for each compound and the quantities of samples injected. Although an attempt to quantitate the data was considered impractical, each sample's HPLC chromatogram was divided into regions of similar polarity for sake of comparison (each chromatogram contains three traces, one representing the solvent composition, a second representing the ultraviolet detector response, and the other representing the fluorescence detector response). The first 17 minutes of a chromatogram was identified as the nonpolar region, and the polar region was determined to start after 32 minutes. The transitional region was the section of the chromatogram between 17 and 32 minutes. The total area for the peaks in each region of polarity was determined with a planimeter. A total area for each region of polarity was divided by the sum of the total area for each chromatogram. This value when multiplied by 100 resulted in a percentage that normalized the chromatogram.

CRC and related studies(16,24) suggest that the transitional region compounds display the highest Ames activity, while the nonpolar region compounds give the lowest Ames activity. Generally, as discussed in the same studies, indirect-acting mutagens were associated more with the nonpolar region and direct-acting mutagens more with the transitional and polar regions.

Table 42 presents the HPLC data prepared to include the normalized percent of chromatogram peak areas with fluorescence and UV detection. Although the UV data was included only for supplementary information in this discussion, the UV response like the fluoresence response was least in the transitional area. In some cases, the UV response was respectively opposite to the fluorescence response in the nonpolar and polar regions. For simplicity, the remaining discussion of HPLC results in Table 42 is concerned only with fluorescence data.

The highest peaks in the transitional region were found in the NYCC for the Fiat N.A. vehicle with and without aftertreatment using EM-329-F. Overall highest response was seen in the polar region especially as found with each vehicle using EM-329-F on the

TABLE 42. NORMALIZED HPLC CHROMATOGRAM PEAK DATA OF PARTICULATE ORGANIC SOLUBLES FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Chromatogram Region[a]	Normalized Percent of Peak Areas by Cycle and Fuel							
		4-bag FTP		HFET		NYCC		85 kph	
		EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	Nonpolar	30[b] (60)[c]	61 (50)	51 (76)	68 (70)	36 (70)	22 (67)	19 (52)	59 (91)
	Transitional	14 (1)	--[d] (--)	7 (1)	-- (--)	21 (1)	12 (2)	13 (3)	11 (1)
	Polar	56 (39)	39 (50)	42 (23)	32 (30)	43 (29)	66 (31)	68 (45)	30 (8)
Fiat N.A./trap	Nonpolar	31 (62)	69 (38)	28 (54)	10 (41)	13 (52)	-- (--)	18 (46)	9 (40)
	Transitional	14 (2)	-- (1)	-- (4)	12 (8)	23 (4)	-- (--)	-- (9)	7 (9)
	Polar	55 (36)	31 (61)	72 (42)	78 (51)	64 (44)	-- (--)	82 (45)	84 (51)
Fiat T.C.	Nonpolar	27 (62)	22 (40)	50 (53)	42 (63)	24 (44)	77 (44)	44 (47)	19 (55)
	Transitional	14 (3)	12 (4)	-- (4)	1 (1)	-- (--)	-- (--)	-- (--)	4 (2)
	Polar	59 (35)	66 (56)	50 (43)	57 (36)	76 (56)	23 (56)	56 (53)	77 (43)
Fiat T.C./trap	Nonpolar	39 (49)	38 (53)	66 (61)	25 (44)	44 (42)	59 (48)	21 (36)	6 (21)
	Transitional	13 (4)	6 (3)	-- (--)	2 (3)	14 (7)	4 (3)	-- (7)	4 (8)
	Polar	48 (47)	56 (44)	34 (39)	73 (53)	42 (51)	37 (49)	79 (57)	90 (71)
Cutlass	Nonpolar	37 (65)	54 (37)	28 (62)	40 (38)	41 (67)	30 (67)	23 (62)	20 (62)
	Transitional	1 (2)	-- (--)	-- (5)	-- (4)	5 (3)	4 (3)	3 (2)	2 (2)
	Polar	62 (33)	46 (63)	72 (33)	60 (58)	54 (30)	66 (30)	74 (36)	78 (36)

[a] Chromatogram region: first 17 minutes is designated nonpolar, 17 to 32 minutes is designated transitional, and beyond 32 minutes is designated polar.

[b] The first value represents the normalized percent of the peak area with a fluorescence wavelength of 418 nm and an excitation wavelength at 313 nm.

[c] The second value in parenthesis represents the normalized percent of the sample peak area with a UV absorbance at 254 nm.

[d] No peak detected

4-bag FTP and both fuels at 85 kph. Sample area response between the same chromatograph regions for the Fiats with and without aftertreatment, shown in Table 42, were not significantly different as obtained during the 4-bag FTP with EM-329-F. The chromatograms, however, did show some differences in sample characteristics between the naturally-aspirated and turbocharged Fiats. These differences plus other sample chromatographic characteristics may be seen in Figures 17 through 22, which include chromatograms of a standard, and of samples from the five vehicle configurations used during the 4-bag FTP with EM-329-F.

J. Benzo(a)pyrene in Organic Solubles

Benzo(a)pyrene (BaP) is an indicator of the many PNA compounds considered potential carcinogens in diesel exhaust particulate. Analysis for BaP was conducted with organic solubles extracted from particulate using benzene/ethanol as previously described in this report. Sufficient organic solubles extracts were obtained to represent each vehicle configuration, cycle, and fuel combination used in this program. The cold FTP and hot FTP samples were combined to provide a 4-bag FTP sample for BaP analysis. The percent solubles of each particulate sample analyzed for BaP were discussed earlier in Section VIII, F of this report.

The BaP emission rates obtained for the various vehicle configurations are listed in Table 43. The MDV's of various samples where BaP was not detected are listed in Table 43, and include results obtained with two different HPLC fluorescence detectors as identified in the same table. Most of the BaP studies were conducted using a fluorescence detector with an improved detection limit, eg., 0.002 μg BaP/filter, employed later

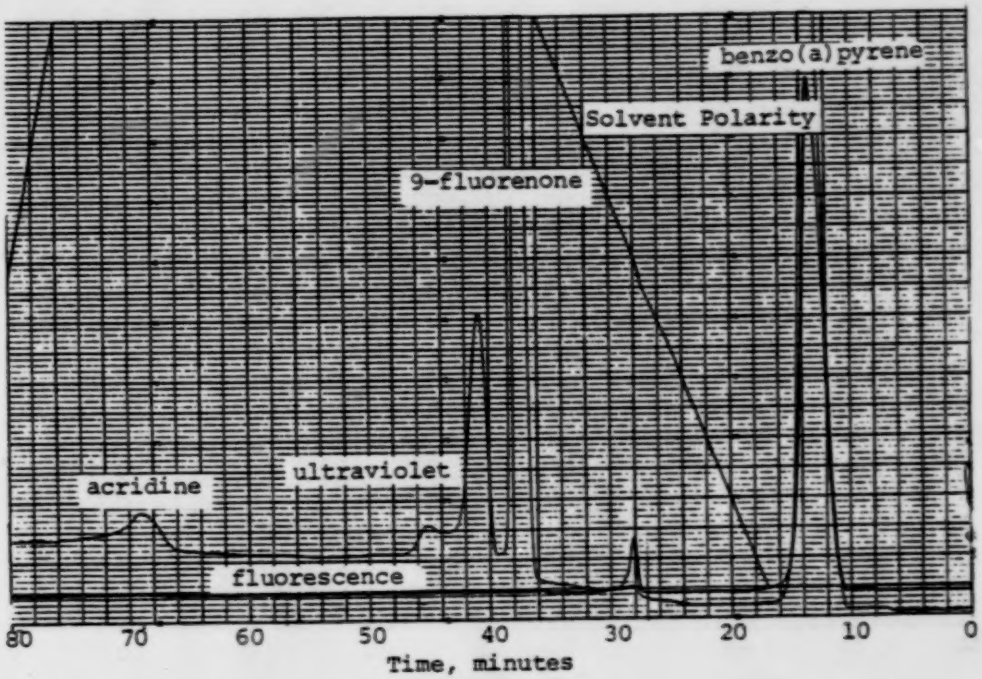

Figure 17. HPLC chromatograms of benzo(a)pyrene, 9-fluorenone, and acridine.

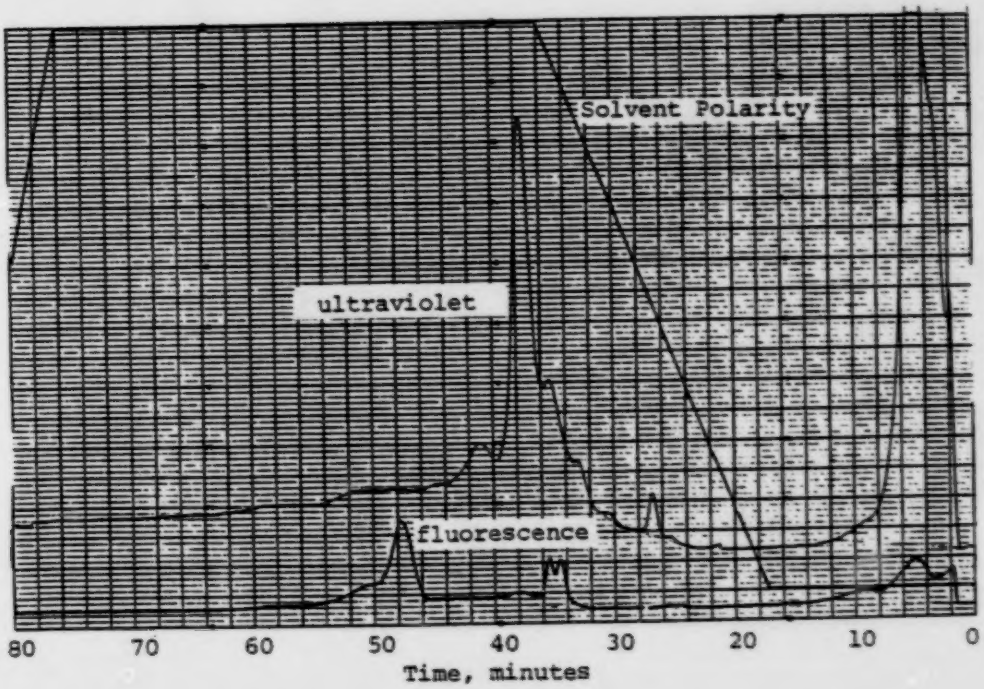

Figure 18. HPLC chromatograms of 4-bag FTP organic solubles from 1981 Oldsmobile Cutlass diesel, fuel EM-329-F.

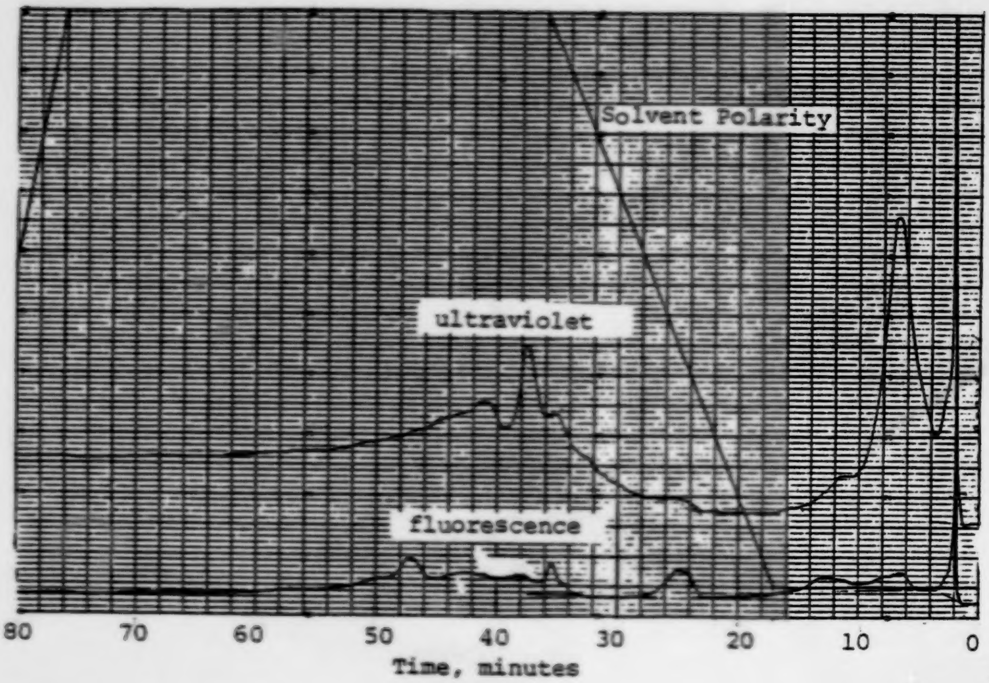

Figure 19. HPLC chromatograms of 4-bag FTP organic solubles from Fiat N.A. diesel without aftertreatment, fuel EM-329-F.

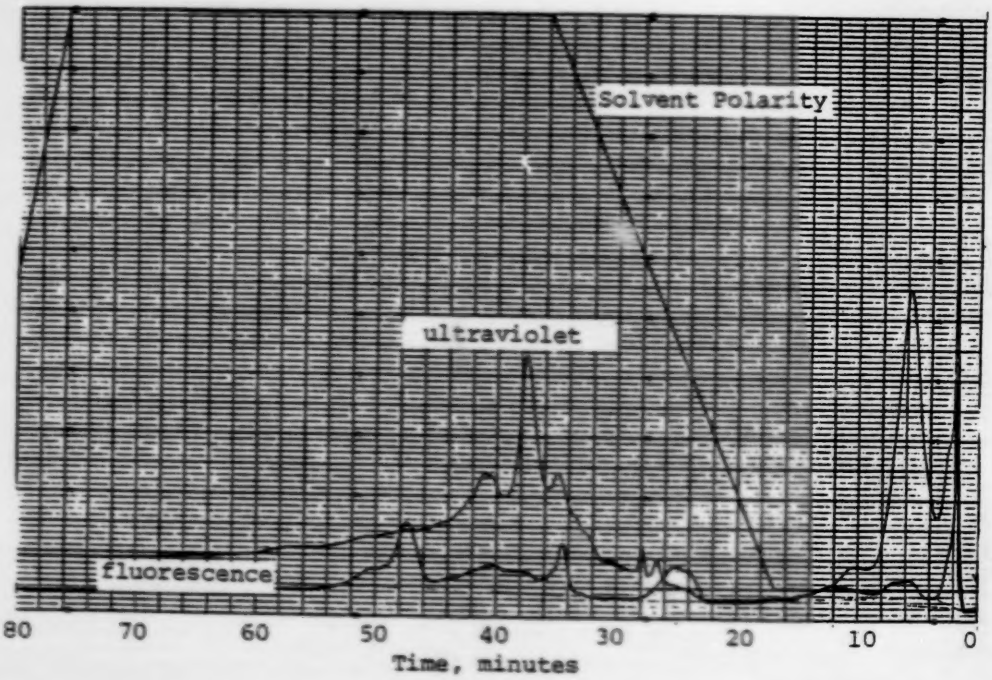

Figure 20. HPLC chromatograms of 4-bag FTP organic solubles from Fiat N.A. diesel with catalytic trap, fuel EM-329-F.

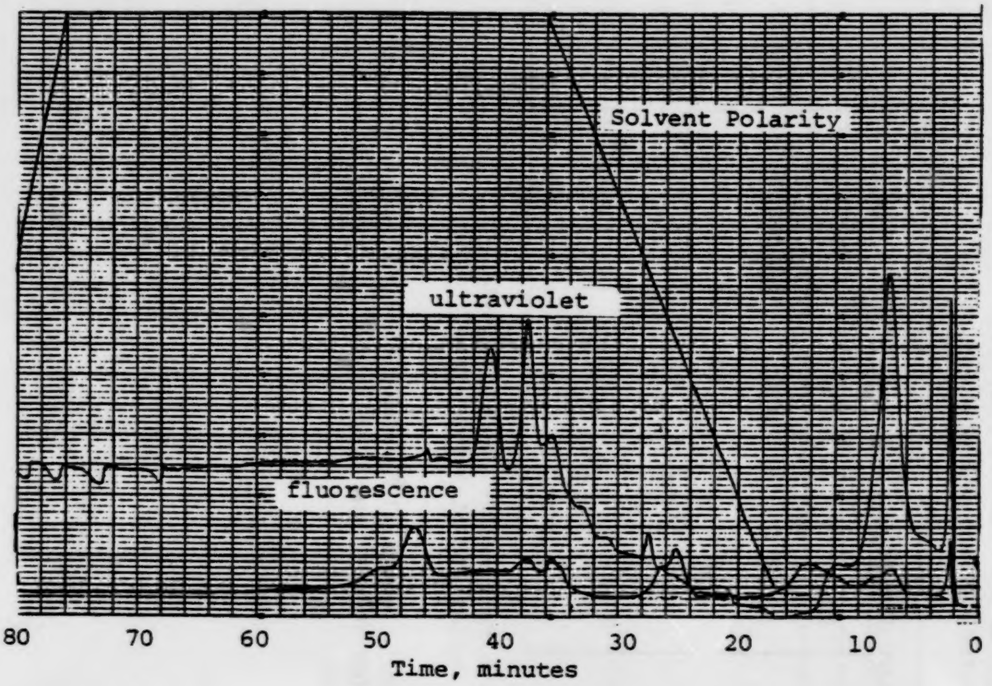

Figure 21 . HPLC chromatograms of 4-bag FTP organic solubles from Fiat T.C. without aftertreatment, fuel EM-329-F.

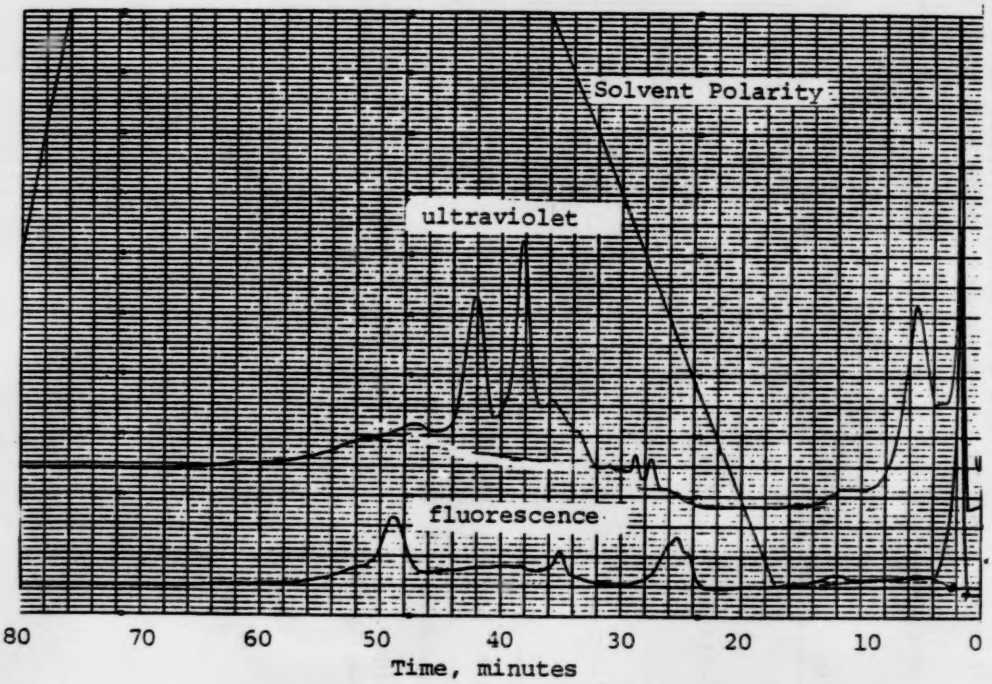

Figure 22. HPLC chromatograms of 4-bag FTP organic solubles from Fiat T.C. diesel with catalytic trap, fuel EM-329-F.

TABLE 43. BENZO(a)PYRENE IN ORGANIC SOLUBLES OF PARTICULATE MATTER, FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	Bap Emission Rates (μg/km) by Cycle and Fuel							
	4-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Fiat N.A.	2.0	1.1	0.67	0.86	7.8	2.9	0.06	0.23
Fiat N.A./trap	N.D.[a]	0.20	N.D.[a]	N.D.[d]	N.D.[b]	0.10	N.D.[c]	N.D.[e]
Fiat T.C.	1.1	3.4	N.D.[d]	0.12	3.0	30.8	N.D.[e]	0.05
Fiat T.C./trap	1.3	1.6	0.02	0.02	0.12	0.20	0.007	0.001
Cutlass	0.31	0.45	0.03	0.15	1.1	1.8	0.005	0.05

[a] 0.01μg/km MDV
[b] 0.12μg/km MDV
[c] 0.008μg/km MDV
} detection limit 0.05μg BaP/filteras analyzed with Perkin-Elmer Model MPF-44A fluorescence detector; used on Fiat N.A. (both fuels) and Fiat N.A./trap (EM-329-F) samples

[d] 0.0006μg/km MDV
[e] 0.0003μg/km MDV
} detection limit 0.002μg BaP/filteras analyzed with Perkin-Elmer Model 650 fluorescence detector; used on Fiat N.A./trap (EM-469-F), and Fiat T.C., Fiat T.C./trap, and Cutlass (both fuels) samples

in the study versus 0.05 μg BaP/filter employed early in the study.

Benzo(a)pyrene emission rates given in Table 43 ranged from 0.001 μg/km to 30.8 μg/km. The BaP emission rate of 30.8 μg/km was obtained on the NYCC using EM-469-F in the turbocharged Fiat without aftertreatment, and was the single BaP emission rate higher than 7.8 μg/km in the study. The extensive use of stop-and-go operation employed on the NYCC may have contributed to the noticeably large BaP emission rate observed. BaP emission rates obtained were generally representative of those obtained in an earlier study(5) at this laboratory using a 1975 Mercedes 240D diesel and a 1977 Rabbit diesel.

Highest BaP emissions on each cycle and with each fuel were associated with either of the two Fiats using no aftertreatment. Although no strong relationship was established between BaP emission and fuel type, BaP emissions were consistently highest on EM-469-F for the turbocharged Fiat without aftertreatment, and for the Cutlass. Overall BaP emissions as compared between the two configurations of the naturally-aspirated Fiat, were reduced by more than 82 percent with catalytic trap use. Reduction of BaP emissions with use of catalytic trap on the turbocharged Fiat was 53 percent on the 4-bag FTP (EM-469-F), 83 percent on HFET (EM-469-F), 97 percent (average) on the NYCC (both fuels), and 98 percent at 85 kph (EM-469-F).

K. Mutagenic Activity of Organic Solubles

Methylene chloride extracts of particulate collected on 500x500 mm filters, as previously discussed in this report, were prepared for Ames bioassay. The separate cold and hot 23-minute FTP extract samples for each run were combined to provide a 4-bag FTP sample for Ames analysis employing tester strains TA1535, TA1537, TA1538 and TA98. The four strains used on the FTP samples were run with and without S-9 activation, except for TA1537 run without S-9 only. The HFET, NYCC, and 85 kph organic extracts for each vehicle and fuel combination were tested using tester strain TA98 without S-9 only. TA1535 detects base pair substitutions, while TA1537, TA1538, and TA98 respond to frameshift mutagens.

The Ames bioassay response of the organic solubles is summarized in Table 44. Detailed Ames bioassay formal reports for each vehicle configuration-fuel combination shown in Table 44 were prepared by the Southwest Foundation for Research and Education. These formal reports are located in Appendix P, and are individually coded to correspond to the respective vehicle configuration-fuel code provided in the vehicle column of Table 44.

All samples showed weak to strong positive mutagenic response in Table 44. TA1535 had the weakest response and TA98 the strongest response generally. Highest mutagenic response overall was observed with the trap-equipped Fiats using TA1537, TA1538, and TA98. TA98 displayed the strongest response of the four strains with either fuel in the 4-bag FTP using most vehicles. On either fuel overall, the 4-bag FTP revertants/μg showed a tendency to increase with S-9 on TA1535 (only slightly) and TA1538, and a tendency to decrease with activation of TA98. Although no consistent trends for fuel effects on reventants/μg were noted in the overall study, sample responses using EM-469-F were somewhat stronger than those using EM-329-F, especially as noted on the naturally-aspirated Fiat without aftertreatment, the turbocharged Fiat without aftertreatment, and the Cutlass.

TABLE 44. AMES BIOASSAY RESPONSE OF ORGANIC SOLUBLES IN PARTICULATE, FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	S-9 Activation	Average Revertants/μg Extract[a] by Cycle, Fuel, and Tester Strain													
		4-bag FTP								HFET		NYCC		85 kph	
		EM-329-F				EM-469-F				EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
		TA1535	TA1537	TA1538	TA98	TA1535	TA1537	TA1538	TA98	TA98	TA98	TA98	TA98	TA98	TA98
Fiat N.A.	w/o	0	0.17	0.40	0.82	0	0.26	0.60	1.24	0.77	1.09	0.88	0.86	0.42	0.52
(1A329&1A469)[c]	w	0.04	--[b]	0.85	1.02	0.07	--	1.20	1.32	--	--	--	--	--	--
Fiat N.A./trap	w/o	0	1.46	2.20	3.70	0	1.86	2.18	5.22	13.86	10.56	5.04	3.63	11.60	9.10
(1B329&1B469)	w	0.04	--	1.92	3.00	0	--	2.81	3.98	--	--	--	--	--	--
Fiat T.C.	w/o	-0.003	0.76	1.06	3.00	0	1.17	2.81	4.63	2.88	5.22	1.46	1.09	3.36	4.90
(3A329&3A469)	w	0.06	--	1.43	1.82	0.06	--	2.36	3.05	--	--	--	--	--	--
Fiat T.C./trap	w/o	0.02	2.10	4.22	4.06	0	1.29	2.54	2.84	8.42	8.72	8.04	1.51[d]	8.62	8.84
(3B329&3B469)	w	0.06	--	1.85	2.68	0.06	--	2.84	2.42	--	--	--	--	--	--
Cutlass	w/o	-0.02	0.71	1.39	3.12	0.03	1.08	1.94	3.24	4.45	4.80	2.00	2.96	2.83	4.70
(2A329&2A469)	w	0.05	--	1.40	1.97	0.04	--	2.33	3.42	--	--	--	--	--	--

[a] slope of dose-response curve

[b] no bioassay was performed

[c] vehicle-fuel code in parenthesis can be referred to similarly coded Ames Formal Report provided in Appendix P

[d] low Ames response possibly related to sample dilution as indicated by high organic extract fraction in Table 36.

As discussed above, the mutagenic response (rev/μg) was found to be significantly stronger with the trap-equipped Fiats than with the same vehicle configurations without aftertreatment. It must be kept in mind, however, that the trap-equipped Fiats also produced less particulate and organics than the same vehicles without exhaust aftertreatment. Therefore, mutagenic response data in revertants/μg in Table 44 were converted to revertants/km in Table 45 to better assess the mutagenic activity of the organic solubles.

Approximate high to low ranking order of vehicles with respect to overall revertants/km were the turbocharged Fiat without aftertreatment, the naturally-aspirated Fiat without aftertreatment, the Cutlass, the turbocharged Fiat with catalytic trap, and the naturally-aspirated Fiat with catalytic trap. General reduction of revertants/km were obtained on the two Fiats with catalytic trap. Revertants/km using the catalytic trap and two fuels on the Fiat N.A. diesel were reduced by an average of 83 percent on the 4-bag FTP, 63 percent on the HFET, 83 percent (EM-469-F only) in NYCC, and 62 percent in the 85 kph. Corresponding reductions of revertants/km using the trap on the turbocharged Fiat were 75 percent on the 4-bag FTP, 68 percent on the HFET, 32 percent on the NYCC, and 88 percent on the 85 kph.

TABLE 45. AMES BIOASSAY RESULTS IN REVERTANTS PER KILOMETER, FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS

Vehicle	S-9 Activation	10^3 Revertants/km[a] by Cycle, Fuel, and Tester Strain													
		4-bag FTP								HFET		NYCC		85 kph	
		EM-329-F				EM-469-F				EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
		TA1535	TA1537	TA1538	TA98	TA1535	TA1537	TA1538	TA98	TA98	TA98	TA98	TA98	TA98	TA98
Fiat N.A.	w/o	0.0	24.	56.	115.	0.0	41.	92.	190.	86.	149.	93.	189.	41.	66.
(1A329&1A469)[c]	w	6.	--[b]	119.	143.	11.	--	184.	203.	--	--	--	--	--	--
Fiat N.A./trap	w/o	0.0	12.	18.	30.	0.0	9.	11.	27.	40.	40.	103.	32.	17.	23.
(1B329&1B469)	w	0.3	--	16.	25.	0.0	--	14.	20.	--	--	--	--	--	--
Fiat T.C.	w/o	0.0	44.	61.	177.	0.0	102.	140.	403.	64.	136.	153.	125.	48.	88.
(3A329&3A469)	w	3.	--	83.	106.	5.	--	206.	265.	--	--	--	--	--	--
Fiat T.C./trap	w/o	0.0	21.	42.	40.	0.0	17.	33.	36.	30.	24.	128.	64.	4.5	12.
(3B329&3B469)	w	0.6	--	18.	27.	0.8	--	37.	31.	--	--	--	--	--	--
Cutlass	w/o	0.0	19.	37.	84.	1.	38.	68.	114.	92.	120.	106.	182.	51.	90.
(2A329&2A469)	w	1.	--	38.	53.	1.	--	82.	120.	--	--	--	--	--	--

[a] calculation includes particulate mass rates based on 47 mm Pallflex filters

[b] no bioassay was performed

[c] vehicle-fuel code in parenthesis can be referred to similarly coded Ames Formal Report provided in Appendix F

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APPENDIX A

TEST RESULTS,
TRAP REGENERATION ON
FIAT NATURALLY-ASPIRATED DIESEL
WITH CATALYTIC TRAP
FUEL EM-469-F

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                                   IDLE   VEHICLE EMISSIONS RESULTS
                                            PROJECT 11-4874-001

TEST NO.   1B2R01   RUN   1                 VEHICLE NO.1B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT             DATE    5/ 7/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                   DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                   ODOMETER 11656 KM( 7244  MILES)
                                            CVS NO.   3

BAROMETER 738.12 MM HG(29.06 IN HG)         DRY BULB TEMP. 27.8 DEG C(82.0 DEG F)
RELATIVE HUMIDITY  40. PCT                  ABS. HUMIDITY  9.6 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                    IDLE

  BLOWER DIF P MM. H2O(IN. H2O)             706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)           569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)
  BLOWER REVOLUTIONS                            3469.
  TOT FLOW STD. CU. METRES(SCF)              33.7 ( 1189.)
  HC  SAMPLE METER/RANGE/PPM                 2.5/14/  20.
  HC  BCKGRD METER/RANGE/PPM                 4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                17.7/13/  16.
  CO  BCKGRD METER/RANGE/PPM                 1.5/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                79.8/ 3/ 1.47
  CO2 BCKGRD METER/RANGE/PCT                 3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                45.9/ 2/  46.
  NOX BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                                9.12
  HC  CONCENTRATION PPM                          16.
  CO  CONCENTRATION PPM                          14.
  CO2 CONCENTRATION PCT                         1.42
  NOX CONCENTRATION PPM                         45.5
  HC  MASS GRAMS                                  .31
  CO  MASS GRAMS                                  .56
  CO2 MASS GRAMS                               874.8
  NOX MASS GRAMS                                 2.82
  PARTICULATE MASS GRAMS                         2.05
  RUN TIME                 SECONDS              126.
     DFC, WET (DRY)                         .890 ( .879)
     SCF, WET (DRY)                        1.000 ( .974)
     VOL (SCM)                                  33.7
     SAM BLR (SCM)                              7.11
     KM  (MEASURED)

  TEST NUMBER,                               1B2R01
  BARONETER,              MM HG               738.1
  HUMIDITY,               G/KG                  9.6
  TEMPERATURE,            DEG C                27.8
   CARBON DIOXIDE,         G/KM
  FUEL CONSUMPTION,       L/100KM

  HYDROCARBONS,           G/KM
  CARBON MONOXIDE,        G/KM
  OXIDES OF NITROGEN,     G/KM
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                                        IDLE   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4074-001

TEST NO.   1B2R02   RUN   1                     VEHICLE NO.1B                   TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                 DATE    5/ 7/81                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                 DIESEL    EM-469-F
TRANSMISSION M5                                 DYNO NO.      2                 ODOMETER 11661 KM(7247  MILES)
                                                CVS NO.   3

BAROMETER 738.12 MM HG(29.06 IN HG)             DRY BULB TEMP. 28.9 DEG C(84.0 DEG F)
RELATIVE HUMIDITY  35. PCT                      ABS. HUMIDITY  9.1 GM/KG        NOX HUMIDITY CORRECTION FACTOR   .95
BAG RESULTS
  TEST CYCLE                                      IDLE

  BLOWER DIF P MM. H2O(IN. H2O)                 706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)               569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)              40.6 (105.0)
  BLOWER REVOLUTIONS                               3445.
  TOT FLOW STD. CU. METRES(SCF)                  33.2 ( 1172.)
  HC  SAMPLE METER/RANGE/PPM                      .9/14/   7.
  HC  BCKGRD METER/RANGE/PPM                     4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                     5.8/13/   5.
  CO  BCKGRD METER/RANGE/PPM                     1.4/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    80.7/ 3/ 1.40
  CO2 BCKGRD METER/RANGE/PCT                     3.8/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                    50.5/ 2/  51.
  NOX BCKGRD METER/RANGE/PPM                      .8/ 2/   1.
  DILUTION FACTOR                                   9.02
  HC  CONCENTRATION PPM                               3.
  CO  CONCENTRATION PPM                               4.
  CO2 CONCENTRATION PCT                             1.43
  NOX CONCENTRATION PPM                             49.8
  HC  MASS GRAMS                                     .06
  CO  MASS GRAMS                                     .15
  CO2 MASS GRAMS                                   870.2
  NOX MASS GRAMS                                    3.00
  PARTICULATE MASS GRAMS                            1.15
  RUN TIME                 SECONDS                  125.
      DFC, WET (DRY)                             .889 ( .879)
      SCF, WET (DRY)                            1.000 ( .975)
      VOL (SCM)                                     33.2
      SAM BLR (SCM)                                 7.10
      KM  (MEASURED)

  TEST NUMBER,                                    1B2R02
  BAROMETER,               MM HG                   738.1
  HUMIDITY,                G/KG                      9.1
  TEMPERATURE,             DEG C                    28.9
   CARBON DIOXIDE,          G/KM
  FUEL CONSUMPTION,        L/100KM

  HYDROCARBONS,            G/KM
  CARBON MONOXIDE,         G/KM
  OXIDES OF NITROGEN,      G/KM
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                                        IDLE   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4074-001

TEST NO.   1B2R03   RUN   1                  VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE     5/ 7/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                    ODOMETER  11666 KM(7250  MILES)
                                             CVS NO.   3

BAROMETER 737.87 MM HG(29.05 IN HG)          DRY BULB TEMP. 29.4 DEG C(85.0 DEG F)
RELATIVE HUMIDITY  36. PCT                   ABS. HUMIDITY  9.6 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                    IDLE

  BLOWER DIF P MM. H2O(IN. H2O)              706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)            569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)           37.8 (100.0)
  BLOWER REVOLUTIONS                            3446.
  TOT FLOW STD. CU. METRES(SCF)               33.4 ( 1100.)
  HC   SAMPLE METER/RANGE/PPM                  .1/14/   1.
  HC   BCKGRD METER/RANGE/PPM                 4.8/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                 5.9/13/   5.
  CO   BCKGRD METER/RANGE/PPM                 1.5/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                70.7/ 3/ 1.44
  CO2  BCKGRD METER/RANGE/PCT                 3.2/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                49.2/ 2/  49.
  NOX  BCKGRD METER/RANGE/PPM                  .6/ 2/   1.
  DILUTION FACTOR                                 9.20
  HC   CONCENTRATION PPM                           -3.
  CO   CONCENTRATION PPM                            4.
  CO2  CONCENTRATION PCT                          1.40
  NOX  CONCENTRATION PPM                          48.7
  HC   MASS GRAMS                                 -.06
  CO   MASS GRAMS                                  .15
  CO2  MASS GRAMS                                856.1
  NOX  MASS GRAMS                                 3.00
  PARTICULATE MASS GRAMS                           .94
  RUN TIME               SECONDS                 125.
       DFC, WET (DRY)                        .892 ( .802)
       SCF, WET (DRY)                       1.000 ( .975)
       VOL (SCM)                                  33.4
       SAM DLR (SCM)                              7.13
       KM  (MEASURED)

  TEST NUMBER,                                  1B2R03
  BAROMETER,               MM HG                 737.9
  HUMIDITY,                G/KG                    9.6
  TEMPERATURE,             DEG C                  29.4
   CARBON DIOXIDE,          G/KM
  FUEL CONSUMPTION,        L/100KM

  HYDROCARBONS,            G/KM
  CARBON MONOXIDE,         G/KM
  OXIDES OF NITROGEN,      G/KM
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APPENDIX B

TEST RESULTS,
FIAT NATURALLY-ASPIRATED DIESEL
WITHOUT AFTERTREATMENT
FUELS EM-329-F AND EM-469-F

SUMMARY OF REGULATED EMISSIONS FROM FIAT N.A. DIESEL RESEARCH VEHICLE, EM-329-F BASE FUEL, NO CATALYST

Test Code	1A329F			1A329H			
Test Type	3-bag FTP			HFET			
Date (1980)	12/20	12/22	12/23	12/20	12/22	12/23	12/23
Run No.	1	2	3	1	2	3	4
HC, g/mi	0.48	0.52	0.48	0.24	----[a]	0.24	0.21
CO, g/mi	1.63	1.67	1.69	0.72	----[a]	0.66	0.63
NO_x, g/mi	1.34	1.32	1.30	0.89	----[a]	0.89	0.85
Particulate, g/mi	0.47	0.38	0.38	0.25	----[a]	0.29	0.26
Fuel, mi/gal	25.6	28.6	28.6	42.2	----[a]	41.6	42.9

Test Code	1A329N				1A329S			
Test Type	NYCC				85 kph steady-state			
Date (1980)	12/20	12/22	12/23	12/23	12/20	12/22	12/23	12/23
Run No.	1	2	3	4	1	2	3	4
HC, g/mi	0.55	0.76	1.00	0.84	0.18	0.21	0.19	0.18
CO, g/mi	2.69	2.99	2.93	3.11	0.55	0.56	0.55	0.55
NO_x, g/mi	2.01	2.00	2.03	2.03	0.87	0.87	0.85	0.85
Particulate, g/mi	0.35	0.42	0.46	0.49	----[a]	0.25	0.25	0.26
Fuel, mi/gal	20.0	19.3	19.0	17.6	42.8	42.5	43.6	43.2

[a] data not acceptable

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                                          FTP     VEHICLE EMISSIONS RESULTS
                                                    PROJECT 11-4874-001

TEST NO.   1A329F   RUN   1                     VEHICLE NC.1A                                 TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT              DATE    12/20/80                              ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                               DIESEL     EM-329-F
TRANSMISSION M5                                 DYNO NO.      2                               ODOMETER 9879.. KM( 6140. MILES)
                                                CVS NO.   3

BAROMETER 755.14 MM HG(29.73 IN HG)             DRY BULB TEMP. 22.8 DEG C(73.0 DEG F)
RELATIVE HUMIDITY  19. PCT                      ABS. HUMIDITY  3.3 GM/KG                      NOX HUMIDITY CORRECTION FACTOR   .80
BAG RESULTS
  BAG NUMBER                                          1                     2                    3                     4
  DESCRIPTION                                  COLD TRANSIENT          STABILIZED            TRANSIENT            STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)                716.3 (28.2)          723.9 (28.5)         716.3 (28.2)         723.9 (28.5)
  BLOWER INLET P MM. H2O(IN. H2O)              579.1 (22.8)          563.9 (22.2)         579.1 (22.8)         584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.8 (100.0)          35.0 ( 95.0)         35.0 ( 95.0)         34.4 ( 94.0)
  BLOWER REVOLUTIONS                              13858.                23788.               13874.               23785.
  TOT FLOW STD. CU. METRES(SCF)                137.7 ( 4863.)        237.7 ( 8394.)       138.5 ( 4890.)       237.5 ( 8386.)
  HC  SAMPLE METER/RANGE/PPM                   30.0/11/  30.         15.8/11/  16.        19.7/11/  20.        15.3/11/  15.
  HC  BCKGRD METER/RANGE/PPM                    2.5/ 1/   3.          2.5/ 1/   3.         2.5/ 1/   3.         2.8/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                   42.1/13/  39.         28.2/13/  26.        31.6/13/  29.        28.0/13/  26.
  CO  BCKGRD METER/RANGE/PPM                     .8/13/   1.           .7/13/   1.          .7/13/   1.          .8/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   38.4/ 3/  .65         21.6/ 3/  .35        29.1/ 3/  .48        20.7/ 3/  .33
  CO2 BCKGRD METER/RANGE/PCT                    3.5/ 3/  .05          3.0/ 3/  .05         3.1/ 3/  .05         3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   25.4/ 2/  25.         15.5/ 2/  16.        19.3/ 2/  19.        14.9/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                     .5/ 2/   1.           .6/ 2/   1.          .6/ 2/   1.          .7/ 2/   1.
  DILUTION FACTOR                                 20.46                 37.96                27.66                39.69
  HC  CONCENTRATION PPM                           28.                   13.                  17.                  13.
  CO  CONCENTRATION PPM                           38.                   25.                  28.                  25.
  CO2 CONCENTRATION PCT                           .60                   .30                  .43                  .29
  NOX CONCENTRATION PPM                          24.9                  14.9                 18.7                 14.2
  HC  MASS GRAMS                                 2.20                  1.84                 1.38                 1.72
  CO  MASS GRAMS                                 6.07                  6.90                 4.52                 6.82
  CO2 MASS GRAMS                               1505.6                1324.0               1100.1               1255.8
  NOX MASS GRAMS                                 5.28                  5.46                 3.99                 5.20
  PARTICULATE MASS GRAMS                         3.31                  1.23                 1.46                 0.00

  HC  GRAMS/KM                                    .38                   .30                  .24                  .28
  CO  GRAMS/KM                                   1.05                  1.11                  .78                 1.10
  CO2 GRAMS/KM                                  261.2                 212.4                190.8                202.3
  NOX GRAMS/KM                                    .92                   .88                  .69                  .84
  FUEL CONSUMPTION BY CB L/100KM                11.08                  9.02                 8.09                 8.60

  RUN TIME              SECONDS                 504.                  867.                 505.                 866.
  MEASURED DISTANCE     KM                      5.76                  6.23                 5.77                 6.21
        DFC, WET (DRY)                                   .965 ( .959)                               .971 ( .965)
        SCF, WET (DRY)                                  1.000 ( .990)                              1.000 ( .990)
        VOL (SCM)                                              375.4                                      376.0
        SAM BLR (SCM)                                          80.42                                      80.43
        KM  (MEASURED)                                         12.00                                      11.97
        FUEL CONSUMPTION L/100KM                               10.01                                       8.35

COMPOSITE RESULTS                                                                                    3-BAG        (4-BAG)
  TEST NUMBER             1A329F                                  CARBON DIOXIDE        G/KM        216.6        ( 213.6)
  BAROMETER     MM HG     755.1                                   FUEL CONSUMPTION      L/100KM       9.19        (  9.06)
  HUMIDITY      G/KG        3.3                                   HYDROCARBONS (THC)    G/KM          .30        (   .29)
  TEMPERATURE   DEG C      22.8                                   CARBON MONOXIDE       G/KM         1.01        (  1.00)
                                                                  OXIDES OF NITROGEN    G/KM          .83        (   .82)
                                                                  PARTICULATES          G/KM         .290        ( 0.000)
                                          HFET   VEHICLE EMISSIONS RESULTS
                                                    PROJECT 11-4074-001

TEST NO.   1A329H   RUN   1                      VEHICLE NO.1A                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        NA FIAT   NOCAT             DATE    12/20/80                     ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                       BAG CART NO.  1                      DIESEL     EM-329-F
TRANSMISSION M5                                  DYNO NO.      2                      ODOMETER 9902.  KM(6154. MILES)
                                                 CVS NO.   3

BAROMETER 754.89 MM HG(29.72 IN HG)              DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  20. PCT                       ABS. HUMIDITY  3.6 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .81
BAG RESULTS
  TEST CYCLE                                         HFET

  BLOWER DIF P MM. H2O(IN. H2O)                 716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)               579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)              43.3 (110.0)
  BLOWER REVOLUTIONS                               21015.
  TOT FLOW STD. CU. METRES(SCF)                 208.3 ( 7357.)
  HC  SAMPLE METER/RANGE/PPM                    23.7/11/  24.
  HC  BCKGRD METER/RANGE/PPM                     2.8/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                    34.4/13/  32.
  CO  BCKGRD METER/RANGE/PPM                     1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    39.4/ 3/  .67
  CO2 BCKGRD METER/RANGE/PCT                     2.8/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                    28.4/ 2/  28.
  NOX BCKGRD METER/RANGE/PPM                      .7/ 2/   1.
  DILUTION FACTOR                                   19.94
  HC  CONCENTRATION PPM                              21.
  CO  CONCENTRATION PPM                              30.
  CO2 CONCENTRATION PCT                              .63
  NOX CONCENTRATION PPM                             27.7
  HC  MASS GRAMS                                     2.53
  CO  MASS GRAMS                                     7.35
  CO2 MASS GRAMS                                  2387.5
  NOX MASS GRAMS                                     8.96
  PARTICULATE MASS GRAMS                             2.56
  RUN TIME               SECONDS                    766.
      DFC, WET (DRY)                            .950 ( .944)
      SCF, WET (DRY)                           1.000 ( .987)
      VOL (SCM)                                    208.3
      SAM BLR (SCM)                                 47.07
      KM  (MEASURED)                                16.43

  TEST NUMBER,                                    1A329H
  BARONETER,             MM HG                     754.9
  HUMIDITY,              G/KG                        3.6
  TEMPERATURE,           DEG C                      23.3
   CARBON DIOXIDE,        G/KM                     145.3
  FUEL CONSUMPTION,      L/100KM                    5.57

  HYDROCARBONS,          G/KM                        .15
  CARBON MONOXIDE,       G/KM                        .45
  OXIDES OF NITROGEN,    G/KM                        .55
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                                   NYCC   VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1A329N   RUN   1                VEHICLE NO.1A                            TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT         DATE    12/20/80                         ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                          DIESEL     EM-329-F
TRANSMISSION M5                            DYNO NO.      2                          ODOMETER 9918 . KM(6164 . MILES)
                                           CVS NO.   3

BAROMETER 754.89 MM HG(29.72 IN HG)        DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  24. PCT                 ABS. HUMIDITY  4.2 GM/KG                 NOX HUMIDITY CORRECTION FACTOR   .82
BAG RESULTS
   TEST CYCLE                                 NYCC

   BLOWER DIF P MM. H2O(IN. H2O)           731.5 (28.8)
   BLOWER INLET P MM. H2O(IN. H2O)         563.9 (22.2)
   BLOWER INLET TEMP. DEG. C(DEG. F)        26.4 ( 79.5)
   BLOWER REVOLUTIONS                        16385.
   TOT FLOW STD. CU. METRES(SCF)           169.1 ( 5970.)
   HC  SAMPLE METER/RANGE/PPM                9.5/11/   9.
   HC  BCKGRD METER/RANGE/PPM                2.8/ 1/   3.
   CO  SAMPLE METER/RANGE/PPM               19.6/13/  18.
   CO  BCKGRD METER/RANGE/PPM                1.2/13/   1.
   CO2 SAMPLE METER/RANGE/PCT               14.6/ 3/  .23
   CO2 BCKGRD METER/RANGE/PCT                2.6/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM                9.8/ 2/  10.
   NOX BCKGRD METER/RANGE/PPM                 .7/ 2/   1.
   DILUTION FACTOR                            57.28
   HC  CONCENTRATION PPM                        7.
   CO  CONCENTRATION PPM                       17.
   CO2 CONCENTRATION PCT                       .19
   NOX CONCENTRATION PPM                       9.1
   HC  MASS GRAMS                              .65
   CO  MASS GRAMS                             3.26
   CO2 MASS GRAMS                            594.9
   NOX MASS GRAMS                             2.43
   PARTICULATE MASS GRAMS                      .43
   RUN TIME              SECONDS              597.
        DFC, WET (DRY)                     .983 ( .975)
        SCF, WET (DRY)                    1.000 ( .990)
        VOL (SCM)                            169.1
        SAM BLR (SCM)                        36.66
        KM  (MEASURED)                        1.95

   TEST NUMBER,                             1A329N
   BAROMETER,           MM HG                754.9
   HUMIDITY,            G/KG                   4.2
   TEMPERATURE,         DEG C                 23.3
    CARBON DIOXIDE,      G/KM                305.5
   FUEL CONSUMPTION,    L/100KM              11.75

   HYDROCARBONS,        G/KM                   .34
   CARBON MONOXIDE,     G/KM                  1.67
   OXIDES OF NITROGEN,  G/KM                  1.25
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1A329S   RUN   1                  VEHICLE NO.1A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT   NOCAT          DATE   12/20/80                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                ODOMETER 9922 . KM( 6167. MILES)
                                             CVS NO.   3

BAROMETER 754.89 MM HG(29.72 IN HG)          DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  24. PCT                   ABS. HUMIDITY  4.2 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .82
BAG RESULTS
  TEST CYCLE                                   85 K

  BLOWER DIF P MM. H2O(IN. H2O)              736.6 (29.0)
  BLOWER INLET P MM. H2O(IN. H2O)            584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)           45.6 (114.0)
  BLOWER REVOLUTIONS                            32954.
  TOT FLOW STD. CU. METRES(SCF)              323.4 (11418.)
  HC  SAMPLE METER/RANGE/PPM                 19.5/11/  19.
  HC  BCKGRD METER/RANGE/PPM                  2.6/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                 29.8/13/  27.
  CO  BCKGRD METER/RANGE/PPM                   .8/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 43.0/ 3/  .73
  CO2 BCKGRD METER/RANGE/PCT                  2.7/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 31.4/ 2/  31.
  NOX BCKGRD METER/RANGE/PPM                   .9/ 2/   1.
  DILUTION FACTOR                               18.15
  HC  CONCENTRATION PPM                          17.
  CO  CONCENTRATION PPM                          26.
  CO2 CONCENTRATION PCT                          .69
  NOX CONCENTRATION PPM                         30.5
  HC  MASS GRAMS                                 3.18
  CO  MASS GRAMS                                 9.83
  CO2 MASS GRAMS                              4113.6
  NOX MASS GRAMS                                15.56
  RUN TIME               SECONDS               1200.
      DFC, WET (DRY)                         .945 ( .938)
      SCF, WET (DRY)                        1.000 ( .986)
      VOL (SCM)                                323.4
      SAM BLR (SCM)                             72.43
      KM  (MEASURED)                            28.68

  TEST NUMBER,                                1A329S
  BAROMETER,             MM HG                 754.9
  HUMIDITY,              G/KG                    4.2
  TEMPERATURE,           DEG C                  23.3
   CARBON DIOXIDE,        G/KM                 143.4
  FUEL CONSUMPTION,      L/100KM                5.49

  HYDROCARBONS,          G/KM                    .11
  CARBON MONOXIDE,       G/KM                    .34
  OXIDES OF NITROGEN,    G/KM                    .54
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                                  FTP    VEHICLE EMISSIONS RESULTS
                                          PROJECT 11-4874-001
TEST NO.   1A329F   RUN   2                VEHICLE NO.1A                       TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL     , NA FIAT    NOCAT       DATE    12/22/80                    ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION M5                            DYNO NO.      2                     ODOMETER 9963  . KM( 6192. MILES)
                                           CVS NO.    3

BAROMETER 751.08 MM HG(29.57 IN HG)        DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  22. PCT                 ABS. HUMIDITY  4.0 GM/KG            NOX HUMIDITY CORRECTION FACTOR   .82
BAG RESULTS
  BAG NUMBER                                     1                 2                   3                   4
  DESCRIPTION                              COLD TRANSIENT      STABILIZED        HOT TRANSIENT         STABILIZED

  BLOWER DIF P MM. H20(IN. H20)            713.7 (28.1)       713.7 (28.1)       713.7 (28.1)        713.7 (28.1)
  BLOWER INLET P MM. H20(IN. H20)          591.7 (22.9)       584.2 (23.0)       584.2 (23.0)        584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)         36.1 ( 97.0)       36.1 ( 97.0)       36.1 ( 97.0)        32.8 ( 91.0)
  BLOWER REVOLUTIONS                          13849.             23805.             13887.              23786.
  TOT FLOW STD. CU. METRES(SCF)            138.6 ( 4892.)     238.1 ( 8407.)     138.9 ( 4904.)      239.3 ( 8451.)
  HC  SAMPLE METER/RANGE/PPM               25.6/11/  26.      19.0/11/  19.      26.1/11/  26.       18.3/11/  18.
  HC  BCKGRD METER/RANGE/PPM                4.5/ 1/   5.       4.3/ 1/   4.       4.3/ 1/   4.        4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM               38.0/13/  35.      30.7/13/  28.      34.1/13/  31.       28.8/13/  26.
  CO  BCKGRD METER/RANGE/PPM                1.4/13/   1.       1.6/13/   1.       1.1/13/   1.        1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT               34.9/ 3/  .58      22.1/ 3/  .36      29.2/ 3/  .48       21.6/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT                3.4/ 3/  .05       3.3/ 3/  .05       3.4/ 3/  .05        3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM               22.7/ 2/  23.      15.5/ 2/  16.      19.0/ 2/  19.       14.8/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                 .7/ 2/   1.        .8/ 2/   1.        .9/ 2/   1.        1.0/ 2/   1.
  DILUTION FACTOR                               22.71              37.00              27.51               37.92
  HC  CONCENTRATION PPM                         21.                15.                22.                 14.
  CO  CONCENTRATION PPM                         33.                26.                30.                 25.
  CO2 CONCENTRATION PCT                         .53                .31                .43                 .30
  NOX CONCENTRATION PPM                         22.0               14.7               18.1                13.8
  HC  MASS GRAMS                                1.70               2.04               1.76                1.89
  CO  MASS GRAMS                                5.39               7.33               4.86                7.02
  CO2 MASS GRAMS                              1354.9             1343.9             1096.5              1300.0
  NOX MASS GRAMS                                4.78               5.49               3.95                5.18
  PARTICULATE MASS GRAMS                        1.43               1.27               1.58                0.00

  HC  GRAMS/KM                                  .30                .33                .31                 .30
  CO  GRAMS/KM                                  .94               1.18                .85                1.13
  CO2 GRAMS/KM                                235.5              216.6              191.4               209.6
  NOX GRAMS/KM                                  .83                .89                .69                 .84
  FUEL CONSUMPTION BY CB L/100KM               9.04               8.34               7.36                8.07

  RUN TIME                SECONDS              505.               867.               506.                867.
  MEASURED DISTANCE       KM                   5.75               6.20               5.73                6.20
      DFC, WET (DRY)                                  .967 ( .960)                          .970 ( .963)
      SCF, WET (DRY)                                 1.000 ( .989)                         1.000 ( .989)
      VOL (SCM)                                             376.6                                 378.2
      SAM BLR (SCM)                                         83.69                                 83.69
      KM  (MEASURED)                                        11.96                                 11.93
      FUEL CONSUMPTION L/100KM                              8.68                                  7.73

COMPOSITE RESULTS
  TEST NUMBER               1A329F                                                          3-BAG        (4-BAG)
  BAROMETER      MM HG   751.1                         CARBON DIOXIDE       G/KM            213.6      ( 211.5)
  HUMIDITY       G/KG      4.0                         FUEL CONSUMPTION     L/100KM          8.22      (   8.14)
  TEMPERATURE    DEG C    23.9                         HYDROCARBONS (THC)   G/KM              .32      (    .31)
                                                       CARBON MONOXIDE      G/KM             1.04      (   1.03)
                                                       OXIDES OF NITROGEN   G/KM              .82      (    .81)
                                                       PARTICULATES         G/KM             .233      ( 0.000)
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                                      NYCC   VEHICLE EMISSIONS RESULTS
                                               PROJECT 11-4874-001
TEST NO.   1A329N    RUN   2                VEHICLE NO.1A                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT          DATE    12/22/80                     ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                      DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.      2                      ODOMETER10016. KM(6225. MILES)
                                            CVS NO.   3

BAROMETER 748.28 MM HG(29.46 IN HG)         DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  25. PCT                  ABS. HUMIDITY  4.6 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .83
BAG RESULTS
   TEST CYCLE                                  NYCC

   BLOWER DIF P MM. H2O(IN. H2O)            711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)          579.1 (22.8)
   BLOWER INLET TEMP. DEG. C(DEG. F)         35.6 ( 96.0)
   BLOWER REVOLUTIONS                          16461.
   TOT FLOW STD. CU. METRES(SCF)            164.2 ( 5796.)
   HC  SAMPLE METER/RANGE/PPM               13.9/11/  14.
   HC  BCKGRD METER/RANGE/PPM                4.4/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM               22.6/13/  21.
   CO  BCKGRD METER/RANGE/PPM                1.5/13/   1.
   CO2 SAMPLE METER/RANGE/PCT               16.2/ 3/  .26
   CO2 BCKGRD METER/RANGE/PCT                3.5/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM               10.4/ 2/  10.
   NOX BCKGRD METER/RANGE/PPM                1.2/ 2/   1.
   DILUTION FACTOR                                51.31
   HC  CONCENTRATION PPM                           10.
   CO  CONCENTRATION PPM                           19.
   CO2 CONCENTRATION PCT                           .21
   NOX CONCENTRATION PPM                           9.2
   HC  MASS GRAMS                                   .91
   CO  MASS GRAMS                                  3.64
   CO2 MASS GRAMS                                 616.6
   NOX MASS GRAMS                                  2.41
   PARTICULATE MASS GRAMS                           .51
   RUN TIME               SECONDS                600.
        DFC, WET (DRY)                      .981 ( .973)
        SCF, WET (DRY)                     1.000 ( .990)
        VOL (SCM)                                164.2
        SAM BLR (SCM)                            36.40
        KM  (MEASURED)                            1.95

   TEST NUMBER,                                 1A329N
   BAROMETER,             MM HG                  748.3
   HUMIDITY,              G/KG                     4.6
   TEMPERATURE,           DEG C                   23.9
    CARBON DIOXIDE,        G/KM                  316.1
   FUEL CONSUMPTION,      L/100KM                12.18

   HYDROCARBONS,          G/KM                     .47
   CARBON MONOXIDE,       G/KM                    1.86
   OXIDES OF NITROGEN,    G/KM                    1.24
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                            PROJECT 11-4874-001

TEST NO.   1A329S   RUN   2                  VEHICLE NO.1A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT           DATE    12/22/80               ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                ODOMETER 10018. KM( 6226. MILES)
                                             CVS NO.   3

BAROMETER 748.03 MM HG(29.45 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  23. PCT                   ABS. HUMIDITY  4.4 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .83
BAG RESULTS
   TEST CYCLE                                  85 K

   BLOWER DIF P MM. H2O(IN. H2O)             711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)           574.0 (22.6)
   BLOWER INLET TEMP. DEG. C(DEG. F)          42.2 (108.0)
   BLOWER REVOLUTIONS                           32960.
   TOT FLOW STD. CU. METRES(SCF)             323.2 (11413.)
   HC  SAMPLE METER/RANGE/PPM                23.8/11/  24.
   HC  BCKGRD METER/RANGE/PPM                 4.7/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                31.5/13/  29.
   CO  BCKGRD METER/RANGE/PPM                 1.6/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                43.7/ 3/  .75
   CO2 BCKGRD METER/RANGE/PCT                 3.1/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                31.4/ 2/  31.
   NOX BCKGRD METER/RANGE/PPM                 1.4/ 2/   1.
   DILUTION FACTOR                              17.81
   HC  CONCENTRATION PPM                          19.
   CO  CONCENTRATION PPM                          27.
   CO2 CONCENTRATION PCT                          .70
   NOX CONCENTRATION PPM                         30.1
   HC  MASS GRAMS                                 3.60
   CO  MASS GRAMS                                10.17
   CO2 MASS GRAMS                              4155.4
   NOX MASS GRAMS                               15.38
   PARTICULATE MASS GRAMS                        4.43
   RUN TIME                 SECONDS            1200.
         DFC, WET (DRY)                      .944 ( .937)
         SCF, WET (DRY)                     1.000 ( .986)
         VOL (SCM)                              323.2
         SAM BLR (SCM)                          71.72
         KM  (MEASURED)                         28.68

   TEST NUMBER,                                1A329S
   BARUMETER,               MM HG               748.0
   HUMIDITY,                G/KG                  4.4
   TEMPERATURE,             DEG C                24.4
    CARBON DIOXIDE,          G/KM               144.9
   FUEL CONSUMPTION,        L/100KM              5.54

   HYDROCARBONS,            G/KM                  .13
   CARBON MONOXIDE,         G/KM                  .35
   OXIDES OF NITROGEN,      G/KM                  .54
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                                         FTP    VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.   1A329F   RUN   3                    VEHICLE NO.1A
VEHICLE MODEL      NA FIAT   NOCAT             DATE    12/23/80                          TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                           ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
TRANSMISSION M5                                DYNO NO.       2                          DIESEL      EM-329-F
                                               CVS NO.    3                              ODOMETER 10050. KM( 6246. MILES)

BAROMETER 743.97 MM HG(29.29 IN HG)            DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  42. PCT                     ABS. HUMIDITY   8.1 GM/KG                 NOX HUMIDITY CORRECTION FACTOR   .92
BAG RESULTS
  BAG NUMBER                                        1                   2                    3                    4
  DESCRIPTION                                 COLD TRANSIENT       STABILIZED          HOT TRANSIENT         STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)        711.2 (28.0)        711.2 (28.0)         711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             571.5 (22.5)        571.5 (22.5)        571.5 (22.5)         571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)            36.1 ( 97.0)        32.2 ( 90.0)        33.3 ( 92.0)         35.0 ( 95.0)
  BLOWER REVOLUTIONS                             13874.              23846.              13878.               23808.
  TOT FLOW STD. CU. METRES(SCF)               136.3 ( 4812.)      236.0 ( 8332.)      137.0 ( 4838.)       234.3 ( 8273.)
  HC  SAMPLE METER/RANGE/PPM                  28.3/11/  28.       19.0/11/  19.       24.4/11/  24.        18.8/11/  19.
  HC  BCKGRD METER/RANGE/PPM                   4.8/ 1/   5.        4.8/ 1/   5.        4.8/ 1/   5.         4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                  45.7/13/  43.       32.1/13/  30.       35.2/13/  33.        30.8/13/  28.
  CO  BCKGRD METER/RANGE/PPM                   3.8/13/   3.        3.1/13/   3.        2.5/13/   2.         2.4/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                  34.9/ 3/  .58       22.6/ 3/  .37       29.0/ 3/  .48        21.5/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT                   3.3/ 3/  .05        3.2/ 3/  .05        3.3/ 3/  .05         2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                  20.4/ 2/  20.       14.2/ 2/  14.       16.7/ 2/  17.        13.3/ 2/  13.
  NOX BCKGRD METER/RANGE/PPM                   1.1/ 2/   1.        1.0/ 2/   1.         .9/ 2/   1.          .8/ 2/   1.
  DILUTION FACTOR                                 22.68               36.13               27.71                38.08
  HC  CONCENTRATION PPM                           24.                 14.                 20.                  14.
  CO  CONCENTRATION PPM                           39.                 26.                 30.                  26.
  CO2 CONCENTRATION PCT                           .54                 .32                 .43                  .30
  NOX CONCENTRATION PPM                          19.3                13.2                15.8                 12.5
  HC  MASS GRAMS                                  1.86                1.95                1.56                 1.91
  CO  MASS GRAMS                                  6.12                7.22                4.73                 7.01
  CO2 MASS GRAMS                               1336.4              1375.6              1076.5               1304.1
  NOX MASS GRAMS                                  4.64                5.50                3.82                 5.17
  PARTICULATE MASS GRAMS                          1.71                1.27                1.38                 0.00

  HC  GRAMS/KM                                    .32                 .31                 .27                  .31
  CO  GRAMS/KM                                   1.06                1.16                 .82                 1.12
  CO2 GRAMS/KM                                  232.3               220.8               187.1                208.9
  NOX GRAMS/KM                                    .81                 .88                 .66                  .83
  FUEL CONSUMPTION BY CB L/100KM                 8.93                8.50                7.19                 8.04

  RUN TIME                  SECONDS              505.                868.                505.                 866.
  MEASURED DISTANCE         KM                   5.75                6.23                5.75                 6.24
      DFC, WET (DRY)                                   .966 ( .953)                             .970 ( .957)
      SCF, WET (DRY)                                  1.000 ( .982)                            1.000 ( .983)
      VOL (SCM)                                               372.3                                    371.3
      SAM BLR (SCM)                                           81.01                                    80.97
      KM  (MEASURED)                                          11.98                                    12.00
      FUEL CONSUMPTION L/100KM                                 8.71                                     7.64

COMPOSITE RESULTS
   TEST NUMBER              1A329F                                                             3-BAG       (4-BAG)
   BAROMETER      MM HG    744.0                        CARBON DIOXIDE         G/KM          214.0      ( 210.4)
   HUMIDITY       G/KG       8.1                        FUEL CONSUMPTION       L/100KM        8.23      (  8.10)
   TEMPERATURE    DEG C     24.4                        HYDROCARBONS (THC)     G/KM            .30      (   .30)
                                                        CARBON MONOXIDE        G/KM           1.05      (  1.04)
                                                        OXIDES OF NITROGEN     G/KM
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                                     HFET   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.   1A329H   RUN   3                  VEHICLE NO.1A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT           DATE    12/23/80               ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                DIESEL    EM-329-F
TRANSMISSION M5                              DYNO NO.      2                ODOMETER 10120. KM( 6290. MILES)
                                             CVS NO.   3

BAROMETER 742.70 MM HG(29.24 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  40. PCT                   ABS. HUMIDITY  8.3 GM/KG        NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
  TEST CYCLE                                       HFET

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)            39.4 (103.0)
  BLOWER REVOLUTIONS                            21026.
  TOT FLOW STD. CU. METRES(SCF)               204.6 ( 7224.)
  HC  SAMPLE METER/RANGE/PPM                  25.6/11/  26.
  HC  BCKGRD METER/RANGE/PPM                   4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                  32.5/13/  30.
  CO  BCKGRD METER/RANGE/PPM                    .9/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                  41.1/ 3/  .70
  CO2 BCKGRD METER/RANGE/PCT                   3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  26.2/ 2/  26.
  NOX BCKGRD METER/RANGE/PPM                   1.1/ 2/   1.
  DILUTION FACTOR                                 19.04
  HC  CONCENTRATION PPM                            21.
  CO  CONCENTRATION PPM                            28.
  CO2 CONCENTRATION PCT                            .65
  NOX CONCENTRATION PPM                           25.2
  HC  MASS GRAMS                                   2.51
  CO  MASS GRAMS                                   6.77
  CO2 MASS GRAMS                                2424.8
  NOX MASS GRAMS                                   9.12
  PARTICULATE MASS GRAMS                           3.01
  RUN TIME             SECONDS                    765.
      DFC, WET (DRY)                          .947 ( .935)
      SCF, WET (DRY)                         1.000 ( .981)
      VOL (SCM)                                  204.6
      SAM BLR (SCM)                               44.62
      KM  (MEASURED)                              16.44

  TEST NUMBER,                                  1A329H
  BAROMETER,           MM HG                     742.7
  HUMIDITY,            G/KG                        8.3
  TEMPERATURE,         DEG C                      25.6
   CARBON DIOXIDE,      G/KM                     147.5
  FUEL CONSUMPTION,    L/100KM                    5.65

  HYDROCARBONS,        G/KM                        .15
  CARBON MONOXIDE,     G/KM                        .41
  OXIDES OF NITROGEN,  G/KM                        .55
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001
TEST NO.    1A329N   RUN   3
VEHICLE MODEL       NA FIAT    NOCAT          VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    DATE    12/23/80                       ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
TRANSMISSION M5                               BAG CART NO.  1                        DIESEL     EM-329-F
                                              DYNO NO.      2                        ODOMETER  10136.KM(6300 . MILES)
                                              CVS NO.   3
BAROMETER 742.70 MM HG(29.24 IN HG)           DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  40. PCT                    ABS. HUMIDITY  8.3 GM/KG
BAG RESULTS                                                                          NOX HUMIDITY CORRECTION FACTOR   .93
  TEST CYCLE                                    NYCC

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)            32.2 ( 90.0)
  BLOWER REVOLUTIONS                             16465.
  TOT FLOW STD. CU. METRES(SCF)               162.7 ( 5744.)
  HC  SAMPLE METER/RANGE/PPM                  16.9/11/  17.
  HC  BCKGRD METER/RANGE/PPM                   4.4/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                  21.4/13/  20.
  CO  BCKGRD METER/RANGE/PPM                   1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                  16.2/ 3/  .26
  CO2 BCKGRD METER/RANGE/PCT                   3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   9.4/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                   1.1/ 2/   1.
  DILUTION FACTOR                                51.27
  HC  CONCENTRATION PPM                          13.
  CO  CONCENTRATION PPM                          18.
  CO2 CONCENTRATION PCT                          .21
  NOX CONCENTRATION PPM                          8.3
  HC  MASS GRAMS                                 1.18
  CO  MASS GRAMS                                 3.46
  CO2 MASS GRAMS                                611.0
  NOX MASS GRAMS                                 2.40
  PARTICULATE MASS GRAMS                          .54
  RUN TIME              SECONDS                 599.
       DFC, WET (DRY)                         .980 ( .968)
       SCF, WET (DRY)                        1.000 ( .985)
       VOL (SCM)                                162.7
       SAM BLR (SCM)                            35.30
       KM  (MEASURED)                            1.90

  TEST NUMBER,                                  1A329N
  BAROMETER,             MM HG                  742.7
  HUMIDITY,              G/KG                     8.3
  TEMPERATURE,           DEG C                   25.6
   CARBON DIOXIDE,        G/KM                  320.9
  FUEL CONSUMPTION,      L/100KM                12.38

  HYDROCARBONS,          G/KM                     .62
  CARBON MONOXIDE,       G/KM                    1.82
  OXIDES OF NITROGEN,    G/KM                    1.26
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1A329S   RUN   3                  VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT           DATE    12/23/80                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                        DIESEL    EM329-F
TRANSMISSION M5                              DYNO NO.      2                        ODOMETER 10138.KM( 6301 MILES)
                                             CVS NO.   3

BAROMETER 741.93 MM HG(29.21 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  40. PCT                   ABS. HUMIDITY  8.3 GM/KG               NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
   TEST CYCLE                                    85 K

   BLOWER DIF P MM. H2O(IN. H2O)              713.7 (28.1)
   BLOWER INLET P MM. H2O(IN. H2O)            561.3 (22.1)
   BLOWER INLET TEMP. DEG. C(DEG. F)           41.1 (106.0)
   BLOWER REVOLUTIONS                            32967.
   TOT FLOW STD. CU. METRES(SCF)              319.9 (11295.)
   HC  SAMPLE METER/RANGE/PPM                 23.5/11/  24.
   HC  BCKGRD METER/RANGE/PPM                  4.5/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                 30.0/13/  28.
   CO  BCKGRD METER/RANGE/PPM                   .4/13/   0.
   CO2 SAMPLE METER/RANGE/PCT                 43.2/ 3/  .74
   CO2 BCKGRD METER/RANGE/PCT                  3.1/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                 27.8/ 2/  28.
   NOX BCKGRD METER/RANGE/PPM                  1.2/ 2/   1.
   DILUTION FACTOR                                18.04
   HC  CONCENTRATION PPM                          19.
   CO  CONCENTRATION PPM                          26.
   CO2 CONCENTRATION PCT                          .69
   NOX CONCENTRATION PPM                         26.7
   HC  MASS GRAMS                                 3.55
   CO  MASS GRAMS                                 9.87
   CO2 MASS GRAMS                              4057.3
   NOX MASS GRAMS                                15.12
   PARTICULATE MASS GRAMS                         4.43
   RUN TIME               SECONDS              1200.
        DFC, WET (DRY)                        .945 ( .932)
        SCF, WET (DRY)                       1.000 ( .980)
        VOL (SCM)                               319.9
        SAM BLR (SCM)                           70.56
        KM  (MEASURED)                          28.75

   TEST NUMBER,                                1A329S
   BAROMETER,           MM HG                   741.9
   HUMIDITY,            G/KG                      8.3
   TEMPERATURE,         DEG C                    25.6
    CARBON DIOXIDE,      G/KM                   141.1
   FUEL CONSUMPTION,    L/100KM                  5.40

   HYDROCARBONS,        G/KM                      .12
   CARBON MONOXIDE,     G/KM                      .34
   OXIDES OF NITROGEN,  G/KM                      .53
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                                   NYCC   VEHICLE EMISSIONS RESULTS
                                           PROJECT 11-4874-001

TEST NO.   1A329N   RUN   4                VEHICLE NO.1A                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT         DATE   12/23/80                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                  DIESEL    EM-329-F
TRANSMISSION M5                            DYNO NO.      2                  ODOMETER 10141. KM(6303 . MILES)
                                           CVS NO.   3

BAROMETER 743.71 MM HG(29.28 IN HG)        DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  37. PCT                 ABS. HUMIDITY  7.6 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .91
BAG RESULTS
  TEST CYCLE                                  NYCC

  BLOWER DIF P MM. H2O(IN. H2O)            711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)          561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)         35.0 ( 95.0)
  BLOWER REVOLUTIONS                          16462.
  TOT FLOW STD. CU. METRES(SCF)            162.1 ( 5724.)
  HC  SAMPLE METER/RANGE/PPM               15.0/11/  15.
  HC  BCKGRD METER/RANGE/PPM                4.3/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM               22.1/13/  20.
  CO  BCKGRD METER/RANGE/PPM                 .2/13/   0.
  CO2 SAMPLE METER/RANGE/PCT               16.9/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                9.9/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                1.3/ 2/   1.
  DILUTION FACTOR                              49.10
  HC  CONCENTRATION PPM                          11.
  CO  CONCENTRATION PPM                          20.
  CO2 CONCENTRATION PCT                          .22
  NOX CONCENTRATION PPM                          8.6
  HC  MASS GRAMS                                1.01
  CO  MASS GRAMS                                3.71
  CO2 MASS GRAMS                               666.1
  NOX MASS GRAMS                                2.43
  PARTICULATE MASS GRAMS                         .59
  RUN TIME              SECONDS                 599.
       DFC, WET (DRY)                       .980 ( .968)
       SCF, WET (DRY)                      1.000 ( .986)
       VOL (SCM)                                162.1
       SAM BLR (SCM)                            35.36
       KM  (MEASURED)                            1.92

  TEST NUMBER,                                1A329N
  BAROMETER,            MM HG                  743.7
  HUMIDITY,             G/KG                     7.6
  TEMPERATURE,          DEG C                   25.6
   CARBON DIOXIDE,       G/KM                  346.4
  FUEL CONSUMPTION,     L/100KM                13.34

  HYDROCARBONS,         G/KM                     .52
  CARBON MONOXIDE,      G/KM                    1.93
  OXIDES OF NITROGEN,   G/KM                    1.26
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1A329S   RUN   4                    VEHICLE NO.1A                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT             DATE   12/23/80                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                  DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.      2                  ODOMETER 10144.KM(6305.. MILES)
                                               CVS NO.   3

BAROMETER 743.71 MM HG(29.28 IN HG)            DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  40. PCT                     ABS. HUMIDITY  8.3 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)                 711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)               576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)              42.2 (108.0)
  BLOWER REVOLUTIONS                               32976.
  TOT FLOW STD. CU. METRES(SCF)                 319.6 (11286.)
  HC  SAMPLE METER/RANGE/PPM                    21.9/11/  22.
  HC  BCKGRD METER/RANGE/PPM                     4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                    29.8/13/  27.
  CO  BCKGRD METER/RANGE/PPM                      .3/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                    43.7/ 3/  .75
  CO2 BCKGRD METER/RANGE/PCT                     3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    28.0/ 2/  28.
  NOX BCKGRD METER/RANGE/PPM                     1.4/ 2/   1.
  DILUTION FACTOR                                  17.82
  HC  CONCENTRATION PPM                            17.
  CO  CONCENTRATION PPM                            26.
  CO2 CONCENTRATION PCT                            .70
  NOX CONCENTRATION PPM                           26.7
  HC  MASS GRAMS                                   3.19
  CO  MASS GRAMS                                   9.82
  CO2 MASS GRAMS                                4083.7
  NOX MASS GRAMS                                  15.10
  PARTICULATE MASS GRAMS                           4.70
  RUN TIME                  SECONDS              1201.
       DFC, WET (DRY)                           .944 ( .932)
       SCF, WET (DRY)                          1.000 ( .980)
       VOL (SCM)                                 319.6
       SAM BLR (SCM)                              70.76
       KM  (MEASURED)                             28.74

  TEST NUMBER,                                  1A329S
  BARONETER,               MM HG                 743.7
  HUMIDITY,                G/KG                    8.3
  TEMPERATURE,             DEG C                  25.6
   CARBON DIOXIDE,          G/KM                 142.1
  FUEL CONSUMPTION,        L/100KM                5.44

  HYDROCARBONS,            G/KM                    .11
  CARBON MONOXIDE,         G/KM                    .34
  OXIDES OF NITROGEN,      G/KM                    .53
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 11-4874-001
TEST NO.   1A329H   RUN   4                 VEHICLE NO.1A                              TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT          DATE   12/24/80                            ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                            DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.      2                            ODOMETER 10146. KM( 6306. MILES)
                                            CVS NO.   3
BAROMETER 743.71 MM HG(29.28 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  40. PCT                  ABS. HUMIDITY  8.3 GM/KG                   NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
  TEST CYCLE                                    HFET

  BLOWER DIF P MM. H2O(IN. H2O)             711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          40.6 (105.0)
  BLOWER REVOLUTIONS                           21028.
  TOT FLOW STD. CU. METRES(SCF)             204.7 ( 7227.)
  HC   SAMPLE METER/RANGE/PPM               21.8/11/  22.
  HC   BCKGRD METER/RANGE/PPM                4.5/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM               30.4/13/  28.
  CO   BCKGRD METER/RANGE/PPM                .5/13/   0.
  CO2  SAMPLE METER/RANGE/PCT               39.8/ 3/  .67
  CO2  BCKGRD METER/RANGE/PCT                3.1/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM               25.7/ 2/  26.
  NOX  BCKGRD METER/RANGE/PPM                1.5/ 2/   2.
  DILUTION FACTOR                               19.74
  HC   CONCENTRATION PPM                        17.
  CO   CONCENTRATION PPM                        27.
  CO2  CONCENTRATION PCT                        .63
  NOX  CONCENTRATION PPM                       24.3
  HC   MASS GRAMS                               2.07
  CO   MASS GRAMS                               6.39
  CO2  MASS GRAMS                             2357.0
  NOX  MASS GRAMS                               8.80
  PARTICULATE MASS GRAMS                        2.70
  RUN TIME              SECONDS                765.
       DFC, WET (DRY)                       .949 ( .937)
       SCF, WET (DRY)                      1.000 ( .981)
       VOL (SCM)                               204.7
       SAM BLR (SCM)                           45.10
       KM  (MEASURED)                          16.45

  TEST NUMBER,                                1A329H
  BAROMETER,             MM HG                 743.7
  HUMIDITY,              G/KG                    8.3
  TEMPERATURE,           DEG C                  25.6
   CARBON DIOXIDE,        G/KM                 143.2
  FUEL CONSUMPTION,      L/100KM                5.48

  HYDROCARBONS,          G/KM                    .13
  CARBON MONOXIDE,       G/KM                    .39
  OXIDES OF NITROGEN,    G/KM                    .53
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SUMMARY OF REGULATED EMISSIONS FROM FIAT N.A. DIESEL RESEARCH VEHICLE, EM-469-F, NO CATALYST

Test code Test type Date (1981) Run No.	1A2F25 3-b FTP 2/16 1	1A2F29 3-b FTP 2/18 2	1A2F33 3-b FTP 3/11 3	1A2H26 HFET 2/16 1	1A2H30 HFET 2/18 2	1A2H34 HFET 3/11 3	1A2H38 HFET 3/13 4
HC, g/mi	0.63	0.61	0.48	0.23	0.29	0.26	0.23
CO, g/mi	1.93	1.92	1.85	0.68	0.71	0.71	0.71
NO_x, g/mi	1.40	1.40	1.40	0.93	1.01	0.97	1.00
Part, g/mi	0.44	0.45	-[a]	0.32	0.35	-	-
fuel, mi/gal	26.9	27.2	28.2	40.5	38.8	39.1	38.7

Test code Test type Date (1981) Run No.	1A2N27 NYCC 2/16 1	1A2N31 NYCC 2/18 2	1A2N35 NYCC 3/11 3	1A2N39 NYCC 3/13 4	1A2S28 85 kph 2/16 1	1A2S32 85 kph 2/18 2	1A2S36 85 kph 3/11 3	1A2S40 85 kph 3/13 4
HC, g/mi	1.13	1.17	1.13	0.95	0.21	0.18	0.19	0.19
CO, g/mi	3.67	3.96	4.12	3.43	0.56	0.55	0.53	0.53
NO_x, g/mi	2.04	2.32	2.37	2.25	0.93	0.98	0.95	0.98
Part, g/mi	0.62	0.62	-	-	0.29	0.30	-	-
fuel, mi/gal	16.6	16.6	15.5	17.9	40.8	40.1	39.7	38.9

[a] - indicates regulated particulate not sampled

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                                          FTP    VEHICLE EMISSIONS RESULTS
                                                  PROJECT 11-4074-001

  TEST NO.   1A2F25   RUN   1                    VEHICLE NO.1A                       TEST WEIGHT  1361. KG( 3000. LBS)
  VEHICLE MODEL     NA FIAT   NOCAT              DATE    2/16/81                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
  ENGINE 2.0 L(122. CID) L-4                     BAG CART NO. 1 / CVS NO.  3         DIESEL     EM-469-F
  TRANSMISSION M5                                DYNO NO.      2                     ODOMETER 10456. KM( 6497. MILES)

  BAROMETER 745.74 MM HG(29.36 IN HG)            DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
  RELATIVE HUMIDITY  38. PCT                     ABS. HUMIDITY  7.1 GM/KG
  BAG RESULTS                                                                        NOX HUMIDITY CORRECTION FACTOR   .89
     BAG NUMBER                                      1                 2                   3                  4
     DESCRIPTION                               COLD TRANSIENT      STABILIZED         HOT TRANSIENT       STABILIZED

     BLOWER DIF P MM. H2O(IN. H2O)             718.8 (28.3)       718.8 (28.3)       721.4 (28.4)       723.9 (28.5)
     BLOWER INLET P MM. H2O(IN. H2O)           584.2 (23.0)       581.7 (22.9)       584.2 (23.0)       584.2 (23.0)
     BLOWER INLET TEMP. DEG. C(DEG. F)          35.6 ( 96.0)       33.9 ( 93.0)       36.1 ( 97.0)       33.3 ( 92.0)
     BLOWER REVOLUTIONS                          13878.             23792.             13849.             23816.
     TOT FLOW STD. CU. METRES(SCF)             137.2 ( 4843.)     235.9 ( 8331.)     136.8 ( 4829.)     236.3 ( 8346.)
     HC  SAMPLE METER/RANGE/PPM                35.7/11/  36.      29.1/11/  29.      31.9/11/  32.      25.0/11/  25.
     HC  BCKGRD METER/RANGE/PPM                 7.6/ 1/   8.      10.2/ 1/  10.      10.2/ 1/  10.       7.4/ 1/   7.
     CO  SAMPLE METER/RANGE/PPM                46.5/13/  44.      35.6/13/  33.      36.7/13/  34.      32.5/13/  30.
     CO  BCKGRD METER/RANGE/PPM                 2.1/13/   2.       2.2/13/   2.       1.3/13/   1.       1.4/13/   1.
     CO2 SAMPLE METER/RANGE/PCT                36.9/ 3/  .62      24.5/ 3/  .40      30.7/ 3/  .51      21.9/ 3/  .35
     CO2 BCKGRD METER/RANGE/PCT                 3.3/ 3/  .05       4.0/ 3/  .06       3.5/ 3/  .05       2.8/ 3/  .04
     NOX SAMPLE METER/RANGE/PPM                21.7/ 2/  22.      15.3/ 2/  15.      18.0/ 2/  18.      14.5/ 2/  15.
     NOX BCKGRD METER/RANGE/PPM                  .8/ 2/   1.        .7/ 2/   1.        .8/ 2/   1.        .8/ 2/   1.
     DILUTION FACTOR                             21.33              33.08              26.04              37.28
     HC  CONCENTRATION PPM                       28.                19.                22.                18.
     CO  CONCENTRATION PPM                       41.                30.                32.                28.
     CO2 CONCENTRATION PCT                       .57                .34                .46                .31
     NOX CONCENTRATION PPM                       20.9               14.6               17.2               13.7
     HC  MASS GRAMS                              2.25               2.62               1.74               2.43
     CO  MASS GRAMS                              6.52               8.35               5.12               7.75
     CO2 MASS GRAMS                            1437.2             1465.9             1143.2             1351.7
     NOX MASS GRAMS                              4.90               5.89               4.02               5.54
     PARTICULATE MASS GRAMS                      1.90               1.38               1.71               0.00

     HC  GRAMS/KM                                .40                .43                .31                .40
     CO  GRAMS/KM                               1.15               1.37                .91               1.26
     CO2 GRAMS/KM                              253.1              240.2              202.3              220.4
     NOX GRAMS/KM                                .86                .97                .71                .90
     FUEL CONSUMPTION BY CB L/100KM             9.51               9.05               7.60               8.31

     RUN TIME               SECONDS             505.               867.               505.               868.
     MEASURED DISTANCE      KM                  5.68               6.10               5.65               6.13
     SCF, DRY                                   .982               .984               .983               .985
         DFC, WET (DRY)                                  .964 ( .952)                          .969 ( .957)
         SCF, WET (DRY)                                 1.000 ( .983)                         1.000 ( .984)
         VOL (SCM)                                             373.1                                 373.1
         SAM BLR (SCM)                                         79.79                                 79.77
         KM  (MEASURED)                                        11.78                                 11.78
         FUEL CONSUMPTION L/100KM                               9.27                                  7.97

 COMPOSITE RESULTS
    TEST NUMBER             1A2F25                                                      3-BAG        (4-BAG)
    BAROMETER      MM HG    745.7             CARBON DIOXIDE          G/KM              232.5       ( 226.6)
    HUMIDITY       G/KG       7.1             FUEL CONSUMPTION        L/100KM            8.75       (   8.53)
    TEMPERATURE    DEG C     23.9             HYDROCARBONS (THC)      G/KM                .39       (    .38)
                                              CARBON MONOXIDE         G/KM               1.20       (   1.17)
                                              OXIDES OF NITROGEN      G/KM                .87       (    .86)
                                              PARTICULATES            G/KM               .270       ( 0.000)
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                                           HFET   VEHICLE EMISSIONS RESULTS
                                                    PROJECT 11-4874-001

TEST NO.   1A2H26   RUN   1                   VEHICLE NO.1A                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT            DATE    2/16/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                   DIESEL    EM-469-F
TRANSMISSION M5                               DYNO NO.      2                   ODOMETER 10478. KM( 6511. MILES)
                                              CVS NO.   3

BAROMETER 746.00 MM HG(29.37 IN HG)           DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  38. PCT                    ABS. HUMIDITY  7.5 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .90
BAG RESULTS
  TEST CYCLE                                     HFET

  BLOWER DIF P MM. H2O(IN. H2O)               723.9 (28.5)
  BLOWER INLET P MM. H2O(IN. H2O)             584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)            36.7 ( 98.0)
  BLOWER REVOLUTIONS                             21027.
  TOT FLOW STD. CU. METRES(SCF)               207.5 ( 7326.)
  HC  SAMPLE METER/RANGE/PPM                  25.7/11/  26.
  HC  BCKGRD METER/RANGE/PPM                   7.4/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM                  33.0/13/  30.
  CO  BCKGRD METER/RANGE/PPM                   1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                  42.2/ 3/  .72
  CO2 BCKGRD METER/RANGE/PCT                   3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  27.3/ 2/  27.
  NOX BCKGRD METER/RANGE/PPM                    .5/ 2/   1.
  DILUTION FACTOR                                18.50
  HC  CONCENTRATION PPM                          19.
  CO  CONCENTRATION PPM                          29.
  CO2 CONCENTRATION PCT                          .67
  NOX CONCENTRATION PPM                         26.8
  HC  MASS GRAMS                                 2.23
  CO  MASS GRAMS                                 6.92
  CO2 MASS GRAMS                              2554.3
  NOX MASS GRAMS                                 9.62
  PARTICULATE MASS GRAMS                         3.26
  RUN TIME             SECONDS                  765.
       DFC, WET (DRY)                         .946 ( .934)
       SCF, WET (DRY)                        1.000 ( .981)
       VOL (SCM)                               207.5
       SAM BLR (SCM)                            44.60
       KM  (MEASURED)                           16.45

  TEST NUMBER,                                 1A2H26
  BAROMETER,           MM HG                    746.0
  HUMIDITY,            G/KG                       7.5
  TEMPERATURE,         DEG C                     24.4
   CARBON DIOXIDE,      G/KM                    155.3
  FUEL CONSUMPTION,    L/100KM                   5.81

  HYDROCARBONS,        G/KM                      .14
  CARBON MONOXIDE,     G/KM                      .42
  OXIDES OF NITROGEN,  G/KM                      .58
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                                            NYCC   VEHICLE EMISSIONS RESULTS
                                                    PROJECT 11-4874-001

 TEST NO.   1A2N27   RUN   1                  VEHICLE NO.1A                             TEST WEIGHT  1361. KG( 3000. LBS)
 VEHICLE MODEL      NA FIAT   NOCAT           DATE    2/16/81                           ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
 ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                           DIESEL    EM-469-F
 TRANSMISSION M5                              DYNO NO.      2                           ODOMETER 10495. KM( 6521. MILES)
                                              CVS NO.    3

 BAROMETER 746.00 MM HG(29.37 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
 RELATIVE HUMIDITY  23. PCT                   ABS. HUMIDITY  4.4 GM/KG                  NOX HUMIDITY CORRECTION FACTOR   .83
 BAG RESULTS
   TEST CYCLE                                    NYCC

   BLOWER DIF P MM. H2O(IN. H2O)              718.8 (28.3)
   BLOWER INLET P MM. H2O(IN. H2O)            581.7 (22.9)
   BLOWER INLET TEMP. DEG. C(DEG. F)           33.9 ( 93.0)
   BLOWER REVOLUTIONS                            16500.
   TOT FLOW STD. CU. METRES(SCF)              164.0 ( 5790.)
   HC  SAMPLE METER/RANGE/PPM                 19.8/11/  20.
   HC  BCKGRD METER/RANGE/PPM                  6.1/ 1/   6.
   CO  SAMPLE METER/RANGE/PPM                 26.5/13/  24.
   CO  BCKGRD METER/RANGE/PPM                  1.7/13/   2.
   CO2 SAMPLE METER/RANGE/PCT                 18.0/ 3/  .29
   CO2 BCKGRD METER/RANGE/PCT                  3.5/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                  9.7/ 2/  10.
   NOX BCKGRD METER/RANGE/PPM                   .5/ 2/   1.
   DILUTION FACTOR                                45.85
   HC  CONCENTRATION PPM                           14.
   CO  CONCENTRATION PPM                           22.
   CO2 CONCENTRATION PCT                           .24
   NOX CONCENTRATION PPM                           9.2
   HC  MASS GRAMS                                  1.31
   CO  MASS GRAMS                                  4.29
   CO2 MASS GRAMS                                 706.7
   NOX MASS GRAMS                                  2.39
   PARTICULATE MASS GRAMS                           .73
   RUN TIME              SECONDS                  601.
        DFC, WET (DRY)                        .978 ( .971)
        SCF, WET (DRY)                       1.000 ( .990)
        VOL (SCM)                                 164.0
        SAM BLR (SCM)                             35.34
        KM  (MEASURED)                             1.88

   TEST NUMBER,                                 1A2N27
   BAROMETER,            MM HG                    746.0
   HUMIDITY,             G/KG                       4.4
   TEMPERATURE,          DEG C                     24.4
    CARBON DIOXIDE,       G/KM                    376.1
   FUEL CONSUMPTION,     L/100KM                  14.18

   HYDROCARBONS,         G/KM                       .70
   CARBON MONOXIDE,      G/KM                      2.28
   OXIDES OF NITROGEN,   G/KM                      1.27
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                                  85 KPH VEHICLE EMISSIONS RESULTS
                                     PROJECT 11-4874-001

TEST NO.   1A2S28   RUN   1                   VEHICLE NO.1A
VEHICLE MODEL       NA FIAT   NOCAT           DATE    2/16/81                TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                               DYNO NO.      2                DIESEL     EM-469-F
                                              CVS NO.   3                    ODOMETER 10496. KM( 6522. MILES)

BAROMETER 745.49 MM HG(29.35 IN HG)           DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  35. PCT                    ABS. HUMIDITY  6.8 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .89
BAG RESULTS
  TEST CYCLE                                     85 K

  BLOWER DIF P MM. H2O(IN. H2O)                718.8 (28.3)
  BLOWER INLET P MM. H2O(IN. H2O)              581.7 (22.9)
  BLOWER INLET TEMP. DEG. C(DEG. F)             38.9 (102.0)
  BLOWER REVOLUTIONS                              32947.
  TOT FLOW STD. CU. METRES(SCF)                324.2 (11447.)
  HC  SAMPLE METER/RANGE/PPM                   25.0/11/  25.
  HC  BCKGRD METER/RANGE/PPM                    6.1/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                   30.0/13/  28.
  CO  BCKGRD METER/RANGE/PPM                     .9/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   45.5/ 3/  .78
  CO2 BCKGRD METER/RANGE/PCT                    2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                   30.3/ 2/  30.
  NOX BCKGRD METER/RANGE/PPM                     .5/ 2/   1.
  DILUTION FACTOR                                 17.04
  HC  CONCENTRATION PPM                            19.
  CO  CONCENTRATION PPM                            26.
  CO2 CONCENTRATION PCT                            .74
  NOX CONCENTRATION PPM                           29.8
  HC  MASS GRAMS                                   3.60
  CO  MASS GRAMS                                   9.85
  CO2 MASS GRAMS                                4387.9
  NOX MASS GRAMS                                  16.40
  PARTICULATE MASS GRAMS                           5.18
  RUN TIME                SECONDS                1201.
       DFC, WET (DRY)                          .941 ( .931)
       SCF, WET (DRY)                         1.000 ( .981)
       VOL (SCM)                                 324.2
       SAM BLR (SCM)                              70.34
       KM  (MEASURED)                             28.40

  TEST NUMBER,                                  1A2S28
  BAROMETER,              MM HG                  745.5
  HUMIDITY,               G/KG                     6.8
  TEMPERATURE,            DEG C                   24.4
   CARBON DIOXIDE,         G/KM                  154.5
  FUEL CONSUMPTION,       L/100KM                 5.77

  HYDROCARBONS,,          G/KM                     .13
  CARBON MONOXIDE,        G/KM                     .35
  OXIDES OF NITROGEN,     G/KM                     .58
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                                                  FTP    VEHICLE EMISSIONS RESULTS
                                                          PROJECT 11-4874-001

 TEST NO.    1A2F29    RUN   2                          VEHICLE NO.1A                            TEST WEIGHT  1361. KG( 3000. LBS)
 VEHICLE MODEL        NA FIAT    NOCAT                  DATE     2/18/81                         ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
 ENGINE 2.0 L(122. CID) L-4                             BAG CART NO. 1 / CVS NO.  3              DIESEL      EM-469-F
 TRANSMISSION M5                                        DYNO NO.      2                          ODOMETER 10538. KM( 6548. MILES)

 BAROMETER 741.68 MM HG(29.20 IN HG)                    DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
 RELATIVE HUMIDITY  46. PCT                             ABS. HUMIDITY  9.3 GM/KG                 NOX HUMIDITY CORRECTION FACTOR   .96
 BAG RESULTS
   BAG NUMBER                                     1                    2                    3                    4
   DESCRIPTION                              COLD TRANSIENT         STABILIZED          HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)            713.7 (28.1)         713.7 (28.1)         711.2 (28.0)         711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)          579.1 (22.8)         579.1 (22.8)         576.6 (22.7)         574.0 (22.6)
   BLOWER INLET TEMP. DEG. C(DEG. F)         37.2 ( 99.0)         35.6 ( 96.0)         38.9 (102.0)         36.1 ( 97.0)
   BLOWER REVOLUTIONS                          13855.               23805.               13851.               23787.
   TOT FLOW STD. CU. METRES(SCF)            135.7 ( 4791.)       233.7 ( 8252.)       135.0 ( 4768.)       233.1 ( 8230.)
   HC  SAMPLE METER/RANGE/PPM               37.0/11/  37.        27.0/11/  27.        36.8/11/  37.        30.4/11/  30.
   HC  BCKGRD METER/RANGE/PPM                9.3/ 1/   9.        10.0/ 1/  10.        10.0/ 1/  10.        10.1/ 1/  10.
   CO  SAMPLE METER/RANGE/PPM               45.6/13/  43.        34.3/13/  32.        37.5/13/  35.        32.7/13/  30.
   CO  BCKGRD METER/RANGE/PPM                 .3/13/   0.          .2/13/   0.          .1/13/   0.          .5/13/   0.
   CO2 SAMPLE METER/RANGE/PCT               36.5/ 3/  .61        23.6/ 3/  .38        32.9/ 3/  .55        22.6/ 3/  .37
   CO2 BCKGRD METER/RANGE/PCT                3.5/ 3/  .05         3.4/ 3/  .05         2.8/ 3/  .04         2.9/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM               20.5/ 2/  21.        14.5/ 2/  15.        17.9/ 2/  18.        13.5/ 2/  14.
   NOX BCKGRD METER/RANGE/PPM                1.1/ 2/   1.          .8/ 2/   1.          .6/ 2/   1.          .8/ 2/   1.
   DILUTION FACTOR                              21.58                34.44                24.16                36.02
   HC  CONCENTRATION PPM                        28.                  17.                  27.                  21.
   CO  CONCENTRATION PPM                        41.                  31.                  34.                  29.
   CO2 CONCENTRATION PCT                        .56                  .33                  .51                  .32
   NOX CONCENTRATION PPM                       19.5                 13.7                 17.3                 12.7
   HC  MASS GRAMS                               2.20                 2.33                 2.12                 2.77
   CO  MASS GRAMS                               6.53                 8.38                 5.32                 7.89
   CO2 MASS GRAMS                            1396.1               1423.7               1252.5               1378.1
   NOX MASS GRAMS                               4.82                 5.86                 4.27                 5.42
   PARTICULATE MASS GRAMS                       1.83                 1.37                 2.06                 0.00

   HC  GRAMS/KM                                 .38                  .38                  .37                  .45
   CO  GRAMS/KM                                1.13                 1.36                  .93                 1.29
   CO2 GRAMS/KM                               242.1                230.7                219.7                225.6
   NOX GRAMS/KM                                 .84                  .95                  .75                  .89
   FUEL CONSUMPTION BY CB L/100KM              9.10                 8.69                 8.26                 8.51

   RUN TIME                 SECONDS          505.                 867.                 505.                 867.
   MEASURED DISTANCE        KM               5.77                 6.17                 5.70                 6.11
   SCF, DRY                                  .980                 .982                 .980                 .982
       DFC, WET (DRY)                                 .965 ( .950)                              .967 ( .953)
       SCF, WET (DRY)                                1.000 ( .981)                             1.000 ( .981)
       VOL (SCM)                                             369.4                                     368.1
       SAM BLR (SCM)                                          78.74                                     78.12
       KM  (MEASURED)                                         11.94                                     11.81
       FUEL CONSUMPTION L/100KM                                8.89                                      8.39

 COMPOSITE RESULTS
   TEST NUMBER           1A2F29                                                                 3-BAG        (4-BAG)
   BAROMETER     MM HG   741.7                          CARBON DIOXIDE          G/KM            230.0       ( 228.5)
   HUMIDITY      G/KG      9.3                          FUEL CONSUMPTION        L/100KM           8.66      (   8.60)
   TEMPERATURE   DEG C    25.0                          HYDROCARBONS (THC)      G/KM              .38       (    .40)
                                                        CARBON MONOXIDE         G/KM             1.19       (   1.17)
                                                        OXIDES OF NITROGEN      G/KM              .87       (    .85)
                                                        PARTICULATES            G/KM             .280       ( 0.000)
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                                   HFET   VEHICLE EMISSIONS RESULTS
                                               PROJECT 11-4874-001
TEST NO.   1A2H30   RUN   2                   VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT   NOCAT           DATE     2/18/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                        DIESEL     EM-469-F
TRANSMISSION M5                               DYNO NO.      2                        ODOMETER 10567. KM( 6566. MILES)
                                              CVS NO.   3

BAROMETER 740.41 MM HG(29.15 IN HG)           DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  50. PCT                    ABS. HUMIDITY 11.0 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                       HFET

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)            38.9 (102.0)
  BLOWER REVOLUTIONS                             21002.
  TOT FLOW STD. CU. METRES(SCF)               204.6 ( 7224.)
  HC  SAMPLE METER/RANGE/PPM                  34.3/11/  34.
  HC  BCKGRD METER/RANGE/PPM                  10.1/ 1/  10.
  CO  SAMPLE METER/RANGE/PPM                  33.8/13/  31.
  CO  BCKGRD METER/RANGE/PPM                    .4/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                  43.5/ 3/  .74
  CO2 BCKGRD METER/RANGE/PCT                   2.8/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                  26.8/ 2/  27.
  NOX BCKGRD METER/RANGE/PPM                    .7/ 2/   1.
  DILUTION FACTOR                                 17.87
  HC  CONCENTRATION PPM                           25.
  CO  CONCENTRATION PPM                           30.
  CO2 CONCENTRATION PCT                           .70
  NOX CONCENTRATION PPM                           26.1
  HC  MASS GRAMS                                   2.92
  CO  MASS GRAMS                                   7.13
  CO2 MASS GRAMS                                2632.4
  NOX MASS GRAMS                                  10.31
  PARTICULATE MASS GRAMS                           3.52
  RUN TIME                  SECONDS               766.
      DFC, WET (DRY)                           .944 ( .929)
      SCF, WET (DRY)                          1.000 ( .977)
      VOL (SCM)                                  204.6
      SAM BLR (SCM)                               43.83
      KM  (MEASURED)                              16.26

  TEST NUMBER,                                 1A2H30
  BAROMETER,             MM HG                  740.4
  HUMIDITY,              G/KG                    11.0
  TEMPERATURE,           DEG C                   26.1
   CARBON DIOXIDE,        G/KM                  161.9
  FUEL CONSUMPTION,      L/100KM                  6.06

  HYDROCARBONS,          G/KM                     .18
  CARBON MONOXIDE,       G/KM                     .44
  OXIDES OF NITROGEN,    G/KM                     .63
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                                             NYCC   VEHICLE EMISSIONS RESULTS
                                                      PROJECT 11-4874-001
TEST NO.   1A2N31   RUN   2
VEHICLE MODEL       NA FIAT    NOCAT            VEHICLE NO.1A                        TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                      DATE     2/18/81                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                 BAG CART NO.  1                      DIESEL     EM-469-F
                                                DYNO NO.      2                      ODOMETER 10583. KM( 6576. MILES)
                                                CVS NO.   3

BAROMETER 739.90 MM HG(29.13 IN HG)             DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  53. PCT                      ABS. HUMIDITY 10.7 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                       NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                 713.7 (28.1)
  BLOWER INLET P MM. H2O(IN. H2O)               576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)              36.1 ( 97.0)
  BLOWER REVOLUTIONS                               16437.
  TOT FLOW STD. CU. METRES(SCF)                 161.0 ( 5685.)
  HC  SAMPLE METER/RANGE/PPM                    27.5/11/  28.
  HC  BCKGRD METER/RANGE/PPM                    12.8/ 1/  13.
  CO  SAMPLE METER/RANGE/PPM                    28.1/13/  26.
  CO  BCKGRD METER/RANGE/PPM                      .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                    17.8/ 3/  .28
  CO2 BCKGRD METER/RANGE/PCT                     2.7/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                     9.7/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                      .8/ 2/   1.
  DILUTION FACTOR                                  46.24
  HC  CONCENTRATION PPM                             15.
  CO  CONCENTRATION PPM                             25.
  CO2 CONCENTRATION PCT                             .24
  NOX CONCENTRATION PPM                             8.9
  HC  MASS GRAMS                                    1.39
  CO  MASS GRAMS                                    4.71
  CO2 MASS GRAMS                                   719.6
  NOX MASS GRAMS                                    2.75
  PARTICULATE MASS GRAMS                             .74
  RUN TIME               SECONDS                   599.
       DFC, WET (DRY)                            .978 ( .962)
       SCF, WET (DRY)                           1.000 ( .980)
       VOL (SCM)                                  161.0
       SAM BLR (SCM)                              34.49
       KM  (MEASURED)                              1.91

  TEST NUMBER,                                   1A2N31
  BAROMETER,             MM HG                    739.9
  HUMIDITY,              G/KG                      10.7
  TEMPERATURE,           DEG C                     25.0
   CARBON DIOXIDE,        G/KM                    376.2
  FUEL CONSUMPTION,      L/100KM                  14.20

  HYDROCARBONS,          G/KM                       .73
  CARBON MONOXIDE,       G/KM                      2.46
  OXIDES OF NITROGEN,    G/KM                      1.44
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                                   85 KPH VEHICLE EMISSIONS RESULTS
                                        PROJECT 11-4874-001

TEST NO.   1A2S32   RUN   2             VEHICLE NO.1A
VEHICLE MODEL       NA FIAT   NOCAT     DATE     2/18/81               TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4              BAG CART NO.  1                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                         DYNO NO.      2                DIESEL     EM-469-F
                                        CVS NO.   3                    ODOMETER 10585. KM( 6577. MILES)

BAROMETER 739.65 MM HG(29.12 IN HG)     DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  47. PCT              ABS. HUMIDITY 10.2 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  TEST CYCLE                               85 K

  BLOWER DIF P MM. H2O(IN. H2O)          716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)        579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)       38.9 (102.0)
  BLOWER REVOLUTIONS                        32919.
  TOT FLOW STD. CU. METRES(SCF)          319.7 (11288.)
  HC  SAMPLE METER/RANGE/PPM             31.1/11/  31.
  HC  BCKGRD METER/RANGE/PPM             14.5/ 1/  15.
  CO  SAMPLE METER/RANGE/PPM             29.3/13/  27.
  CO  BCKGRD METER/RANGE/PPM               .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT             46.8/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT              3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM             29.5/ 2/  30.
  NOX BCKGRD METER/RANGE/PPM               .9/ 2/   1.
  DILUTION FACTOR                           16.51
  HC  CONCENTRATION PPM                       17.
  CO  CONCENTRATION PPM                       26.
  CO2 CONCENTRATION PCT                       .76
  NOX CONCENTRATION PPM                     28.7
  HC  MASS GRAMS                              3.23
  CO  MASS GRAMS                              9.68
  CO2 MASS GRAMS                          4455.3
  NOX MASS GRAMS                             17.25
  PARTICULATE MASS GRAMS                      5.22
  RUN TIME               SECONDS           1200.
      DFC, WET (DRY)                     .939 ( .925)
      SCF, WET (DRY)                    1.000 ( .977)
      VOL (SCM)                            319.7
      SAM BLR (SCM)                         68.10
      KM  (MEASURED)                        28.36

  TEST NUMBER,                            1A2S32
  BAROMETER,            MM HG              739.6
  HUMIDITY,             G/KG                10.2
  TEMPERATURE,          DEG C               26.1
   CARBON DIOXIDE,       G/KM              157.1
  FUEL CONSUMPTION,     L/100KM             5.87

  HYDROCARBONS,         G/KM                 .11
  CARBON MONOXIDE,      G/KM                 .34
  OXIDES OF NITROGEN,   G/KM                 .61
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                                               FTP    VEHICLE EMISSIONS RESULTS
                                                        PROJECT 11-4874-001

TEST NO.   1A2F33   RUN   3                    VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL     , NA FIAT   NOCAT            DATE    3/11/81                        ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO. 1 / CVS NO.  3            DIESEL    EM-469-F
TRANSMISSION M5                                DYNO NO.      2                        ODOMETER 10626. KM( 6603. MILES)

BAROMETER 747.52 MM HG(29.43 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  42. PCT                     ABS. HUMIDITY  8.5 GM/KG               NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
   BAG NUMBER                                       1                  2                   3                   4
   DESCRIPTION                               COLD TRANSIENT        STABILIZED         HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)              716.3 (28.2)       718.8 (28.3)       718.8 (28.3)        718.6 (28.3)
   BLOWER INLET P MM. H2O(IN. H2O)            581.7 (22.9)       581.7 (22.9)       581.7 (22.9)        581.7 (22.9)
   BLOWER INLET TEMP. DEG. C(DEG. F)           35.6 ( 96.0)       33.9 ( 93.0)       35.6 ( 96.0)        33.3 ( 92.0)
   BLOWER REVOLUTIONS                            13865.             23816.             13855.              23811.
   TOT FLOW STD. CU. METRES(SCF)              136.4 ( 4816.)     234.9 ( 8295.)     136.3 ( 4812.)      235.2 ( 8304.)
   HC  SAMPLE METER/RANGE/PPM                 30.1/11/  30.      21.1/11/  21.      27.9/11/  28.       26.4/11/  26.
   HC  BCKGRD METER/RANGE/PPM                  6.6/ 1/   7.       7.8/ 1/   8.       7.8/ 1/   8.       14.5/ 1/  15.
   CO  SAMPLE METER/RANGE/PPM                 45.1/13/  42.      33.9/13/  31.      34.7/13/  32.       32.6/13/  30.
   CO  BCKGRD METER/RANGE/PPM                   .8/13/   1.        .8/13/   1.        .6/13/   1.         .5/13/   0.
   CO2 SAMPLE METER/RANGE/PCT                 35.1/ 3/  .59      22.6/ 3/  .37      30.2/ 3/  .50       21.5/ 3/  .35
   CO2 BCKGRD METER/RANGE/PCT                  2.8/ 3/  .04       2.6/ 3/  .04       2.4/ 3/  .04        2.6/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM                 20.8/ 2/  21.      14.4/ 2/  14.      17.8/ 2/  18.       13.3/ 2/  13.
   NOX BCKGRD METER/RANGE/PPM                   .4/ 2/   0.        .5/ 2/   1.        .5/ 2/   1.         .5/ 2/   1.
   DILUTION FACTOR                               22.53              36.10              26.53               37.98
   HC  CONCENTRATION PPM                         24.                14.                20.                 12.
   CO  CONCENTRATION PPM                         41.                30.                31.                 29.
   CO2 CONCENTRATION PCT                         .55                .33                .46                 .31
   NOX CONCENTRATION PPM                        20.4               13.9               17.3                12.8
   HC  MASS GRAMS                               1.87               1.83               1.60                1.66
   CO  MASS GRAMS                               6.43               8.19               4.89                7.94
   CO2 MASS GRAMS                             1364.9             1408.2             1157.5              1328.2
   NOX MASS GRAMS                               4.96               5.83               4.21                5.37

   HC  GRAMS/KM                                  .33                .29                .28                 .27
   CO  GRAMS/KM                                 1.12               1.32                .85                1.28
   CO2 GRAMS/KM                                237.8              226.9              201.3               213.8
   NOX GRAMS/KM                                  .86                .94                .73                 .86
   FUEL CONSUMPTION BY CB L/100KM               8.93               8.54               7.56                8.04

   RUN TIME               SECONDS               505.               866.               505.                868.
   MEASURED DISTANCE      KM                    5.74               6.21               5.75                6.21
   SCF, DRY                                     .981               .983               .982                .983
        DFC, WET (DRY)                                   .966 ( .953)                          .970 ( .956)
        SCF, WET (DRY)                                  1.000 ( .982)                         1.000 ( .983)
        VOL (SCM)                                               371.3                                 371.4
        SAM BLR (SCM)                                           79.95                                 79.90
        KM  (MEASURED)                                          11.95                                 11.96
        FUEL CONSUMPTION L/100KM                                 8.73                                  7.81

COMPOSITE RESULTS                                                                                    3-BAG       (4-BAG)
   TEST NUMBER            1A2F33                                 CARBON DIOXIDE         G/KM        222.1       ( 218.2)
   BAROMETER      MM HG   747.5                                  FUEL CONSUMPTION       L/100KM      8.35       (  8.20)
   HUMIDITY       G/KG      8.5                                  HYDROCARBONS (THC)     G/KM          .30       (   .29)
   TEMPERATURE    DEG C    25.0                                  CARBON MONOXIDE        G/KM         1.15       (  1.14)
                                                                 OXIDES OF NITROGEN     G/KM          .87       (   .84)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1A2H34   RUN   3                 VEHICLE NO.1A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT   NOCAT          DATE     3/11/81               ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                ODOMETER 10651. KM( 6618. MILES)
                                            CVS NO.   3

BAROMETER 747.01 MM HG(29.41 IN HG)         DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  42. PCT                  ABS. HUMIDITY  8.5 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .93
BAG RESULTS
  TEST CYCLE                                   HFET

  BLOWER DIF P MM. H2O(IN. H2O)             718.8 (28.3)
  BLOWER INLET P MM. H2O(IN. H2O)           584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.7 ( 98.0)
  BLOWER REVOLUTIONS                          21002.
  TOT FLOW STD. CU. METRES(SCF)             205.6 ( 7260.)
  HC  SAMPLE METER/RANGE/PPM                30.4/11/  30.
  HC  BCKGRD METER/RANGE/PPM                 8.8/ 1/   9.
  CO  SAMPLE METER/RANGE/PPM                33.4/13/  31.
  CO  BCKGRD METER/RANGE/PPM                  .3/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                43.7/ 3/  .75
  CO2 BCKGRD METER/RANGE/PCT                 3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                27.1/ 2/  27.
  NOX BCKGRD METER/RANGE/PPM                  .2/ 2/   0.
  DILUTION FACTOR                              17.79
  HC  CONCENTRATION PPM                        22.
  CO  CONCENTRATION PPM                        30.
  CO2 CONCENTRATION PCT                        .70
  NOX CONCENTRATION PPM                       26.9
  HC  MASS GRAMS                               2.62
  CO  MASS GRAMS                               7.11
  CO2 MASS GRAMS                            2627.0
  NOX MASS GRAMS                               9.87
  RUN TIME                  SECONDS           765.
     DFC, WET (DRY)                         .944 ( .931)
     SCF, WET (DRY)                        1.000 ( .979)
     VOL (SCM)                                205.6
     SAM BLR (SCM)                            44.10
     KM  (MEASURED)                           16.33

  TEST NUMBER,                               1A2H34
  BARÓMETER,              MM HG               747.0
  HUMIDITY,               G/KG                  8.5
  TEMPERATURE,            DEG C                25.0
   CARBON DIOXIDE,         G/KM               160.9
  FUEL CONSUMPTION,      L/100KM                6.02

  HYDROCARBONS,           G/KM                  .16
  CARBON MONOXIDE,        G/KM                  .44
  OXIDES OF NITROGEN,     G/KM                  .60
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                   PROJECT 11-4874-001
TEST NO.   1A2N35   RUN   3
VEHICLE MODEL        NA FIAT   NOCAT              VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                        DATE     3/11/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                   BAG CART NO.  1                        DIESEL     EM-465-F
                                                  DYNO NO.      2                        ODOMETER 10667. KM( 6628. MILES)
                                                  CVS NO.   3
BAROMETER 746.51 MM HG(29.39 IN HG)
RELATIVE HUMIDITY  44. PCT                        DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
BAG RESULTS                                       ABS. HUMIDITY  7.9 GM/KG              NOX HUMIDITY CORRECTION FACTOR   .92
  TEST CYCLE
                                                     NYCC
  BLOWER DIF P MM. H2O(IN. H2O)                   713.7 (28.1)
  BLOWER INLET P MM. H2O(IN. H2O)                 579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)                34.4 ( 94.0)
  BLOWER REVOLUTIONS                                16452.
  TOT FLOW STD. CU. METRES(SCF)                   161.7 ( 5710.)
  HC   SAMPLE METER/RANGE/PPM                     21.0/11/  21.
  HC   BCKGRD METER/RANGE/PPM                      6.8/ 1/   7.
  CO   SAMPLE METER/RANGE/PPM                     29.3/13/  27.
  CO   BCKGRD METER/RANGE/PPM                       .4/13/   0.
  CO2  SAMPLE METER/RANGE/PCT                     19.5/ 3/  .31
  CO2  BCKGRD METER/RANGE/PCT                      3.6/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM                     10.2/ 2/  10.
  NOX  BCKGRD METER/RANGE/PPM                       .3/ 2/   0.
  DILUTION FACTOR                                    42.15
  HC   CONCENTRATION PPM                             14.
  CO   CONCENTRATION PPM                             26.
  CO2  CONCENTRATION PCT                             .26
  NOX  CONCENTRATION PPM                             9.9
  HC   MASS GRAMS                                    1.34
  CO   MASS GRAMS                                    4.90
  CO2  MASS GRAMS                                  767.6
  NOX  MASS GRAMS                                    2.81
  RUN TIME                  SECONDS                600.
       DFC, WET (DRY)                             .976 ( .963)
       SCF, WET (DRY)                            1.000 ( .983)
       VOL (SCM)                                  161.7
       SAM BLR (SCM)                              34.60
       KM  (MEASURED)                              1.91

TEST NUMBER,                                      1A2N35
BAROMETER,              MM HG                     746.5
HUMIDITY,               G/KG                        7.9
TEMPERATURE,            DEG C                      23.3
 CARBON DIOXIDE,        G/KM                      401.6
FUEL CONSUMPTION,       L/100KM                   15.14

HYDROCARBONS,           G/KM                        .70
CARBON MONOXIDE,        G/KM                       2.56
OXIDES OF NITROGEN,     G/KM                       1.47
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                                                85 KPH VEHICLE EMISSIONS RESULTS
                                                     PROJECT 11-4874-001

TEST NO.   1A2S36   RUN  3                        VEHICLE NO.1A                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT    NOCAT               DATE    3/11/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                        BAG CART NO.  1                   DIESEL     EM-465-F
TRANSMISSION M5                                   DYNO NO.      2                   ODOMETER 10660. KM( 6629. MILES)
                                                  CVS NO.   3

BAROMETER 746.76 MM HG(29.40 IN HG)               DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  44. PCT                        ABS. HUMIDITY  7.9 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .92
BAG RESULTS
  TEST CYCLE                                         85 K

  BLOWER DIF P MM. H2O(IN. H2O)                   716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)                 579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)                38.3 (101.0)
  BLOWER REVOLUTIONS                                 32965.
  TOT FLOW STD. CU. METRES(SCF)                   322.1 (11372.)
  HC  SAMPLE METER/RANGE/PPM                      23.8/11/  24.
  HC  BCKGRD METER/RANGE/PPM                       5.2/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                      28.0/13/  26.
  CO  BCKGRD METER/RANGE/PPM                        .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                      47.0/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT                       2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                      30.4/ 2/  30.
  NOX BCKGRD METER/RANGE/PPM                        .5/ 2/   1.
  DILUTION FACTOR                                     16.45
  HC  CONCENTRATION PPM                                17.
  CO  CONCENTRATION PPM                                25.
  CO2 CONCENTRATION PCT                                .77
  NOX CONCENTRATION PPM                               29.9
  HC  MASS GRAMS                                       3.52
  CO  MASS GRAMS                                       9.31
  CO2 MASS GRAMS                                    4528.1
  NOX MASS GRAMS                                      16.89
  RUN TIME                 SECONDS                   1201.
       DFC, WET (DRY)                              .939 ( .926)
       SCF, WET (DRY)                             1.000 ( .978)
       VOL (SCM)                                     322.1
       SAM BLR (SCM)                                 69.34
       KM  (MEASURED)                                28.50

  TEST NUMBER,                                      1A2S36
  BARONETER,              MM HG                      746.8
  HUMIDITY,               G/KG                         7.9
  TEMPERATURE,            DEG C                       23.3
   CARBON DIOXIDE,         G/KM                      158.9
  FUEL CONSUMPTION,       L/100KM                     5.93

  HYDROCARBONS,           G/KM                         .12
  CARBON MONOXIDE,        G/KM                         .33
  OXIDES OF NITROGEN,     G/KM                         .59
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.   1A2H38   RUN   4                    VEHICLE NO.1A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        NA FIAT   NOCAT           DATE    3/13/81                        ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                        DIESEL    EM-469-F
TRANSMISSION M5                                DYNO NO.      2                        ODOMETER 10717. KM( 6659. MILES)
                                               CVS NO.   3

BAROMETER 742.70 MM HG(29.24 IN HG)            DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  38. PCT                     ABS. HUMIDITY  7.5 GM/KG               NOX HUMIDITY CORRECTION FACTOR   .90
BAG RESULTS
  TEST CYCLE                                     HFET

  BLOWER DIF P MM. H2O(IN. H2O)               -713.7 (28.1)
  BLOWER INLET P MM. H2O(IN. H2O)              579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.2 ( 99.0)
  BLOWER REVOLUTIONS                             21018.
  TOT FLOW STD. CU. METRES(SCF)               205.0 ( 7239.)
  HC  SAMPLE METER/RANGE/PPM                  22.9/11/  23.
  HC  BCKGRD METER/RANGE/PPM                   4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                  33.5/13/  31.
  CO  BCKGRD METER/RANGE/PPM                    .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                  43.3/ 3/  .74
  CO2 BCKGRD METER/RANGE/PCT                   2.1/ 3/  .03
  NOX SAMPLE METER/RANGE/PPM                  28.6/ 2/  29.
  NOX BCKGRD METER/RANGE/PPM                    .1/ 2/   0.
  DILUTION FACTOR                                17.99
  HC  CONCENTRATION PPM                           19.
  CO  CONCENTRATION PPM                           30.
  CO2 CONCENTRATION PCT                           .71
  NOX CONCENTRATION PPM                          28.5
  HC  MASS GRAMS                                  2.26
  CO  MASS GRAMS                                  7.16
  CO2 MASS GRAMS                                2661.9
  NOX MASS GRAMS                                 10.11
  RUN TIME               SECONDS                  765.
      DFC, WET (DRY)                          .944 ( .933)
      SCF, WET (DRY)                         1.000 ( .981)
      VOL (SCM)                                  205.0
      SAM BLR (SCM)                              44.41
      KM  (MEASURED)                             16.37

  TEST NUMBER,                                  1A2H38
  BAROMETER,           MM HG                     742.7
  HUMIDITY,            G/KG                        7.5
  TEMPERATURE,         DEG C                      24.4
   CARBON DIOXIDE,      G/KM                     162.6
  FUEL CONSUMPTION,    L/100KM                    6.08

  HYDROCARBONS,        G/KM                        .14
  CARBON MONOXIDE,     G/KM                        .44
  OXIDES OF NITROGEN,  G/KM                        .62
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                                    NYCC   VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001
TEST NO.    1A2N39   RUN  4
VEHICLE MODEL        NA FIAT   NOCAT         VEHICLE NO.1A                  TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                   DATE     3/13/81               ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                              BAG CART NO.  1                DIESEL     EM-469-F
                                             DYNO NO.      2                ODOMETER 10733. KM( 6669. MILES)
                                             CVS NO.    3

BAROMETER 742.19 MM HG(29.22 IN HG)          DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  38. PCT                   ABS. HUMIDITY  7.1 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .89
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)             713.7 (28.1)
  BLOWER INLET P MM. H2O(IN. H2O)           579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)          33.3 ( 92.0)
  BLOWER REVOLUTIONS                          16476.
  TOT FLOW STD. CU. METRES(SCF)             161.1 ( 5688.)
  HC  SAMPLE METER/RANGE/PPM                15.5/11/  16.
  HC  BCKGRD METER/RANGE/PPM                 3.7/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                23.8/13/  22.
  CO  BCKGRD METER/RANGE/PPM                  .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                16.7/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                 3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 9.7/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                  .2/ 2/   0.
  DILUTION FACTOR                              49.67
  HC  CONCENTRATION PPM                        12.
  CO  CONCENTRATION PPM                        21.
  CO2 CONCENTRATION PCT                        .22
  NOX CONCENTRATION PPM                        9.5
  HC  MASS GRAMS                               1.10
  CO  MASS GRAMS                               3.99
  CO2 MASS GRAMS                              652.1
  NOX MASS GRAMS                               2.62
  RUN TIME                 SECONDS            600.
       DFC, WET (DRY)                       .980 ( .968)
       SCF, WET (DRY)                      1.000 ( .985)
       VOL (SCM)                              161.1
       SAM BLR (SCM)                          34.25
       KM  (MEASURED)                          1.87

  TEST NUMBER,                                1A2N39
  BAROMETER,              MM HG               742.2
  HUMIDITY,               G/KG                  7.1
  TEMPERATURE,            DEG C                23.9
   CARBON DIOXIDE,         G/KM               348.9
  FUEL CONSUMPTION,       L/100KM             13.15

  HYDROCARBONS,           G/KM                  .59
  CARBON MONOXIDE,        G/KM                 2.13
  OXIDES OF NITROGEN,     G/KM                 1.40
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1A2S40    RUN   4                 VEHICLE NO.1A                         TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT    NOCAT         DATE    3/13/81                       ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                       DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                       ODOMETER 10735. KM( 6672. MILES)
                                             CVS NO.   3

BAROMETER 741.93 MM HG(29.21 IN HG)          DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  36. PCT                   ABS. HUMIDITY  7.3 GM/KG              NOX HUMIDITY CORRECTION FACTOR   .90
BAG RESULTS
  TEST CYCLE                                    85 K

  BLOWER DIF P MM. H2O(IN. H2O)              718.8 (28.3)
  BLOWER INLET P MM. H2O(IN. H2O)            579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)          38.9 (102.0)
  BLOWER REVOLUTIONS                            32947.
  TOT FLOW STD. CU. METRES(SCF)              319.1 (11268.)
  HC  SAMPLE METER/RANGE/PPM                 22.1/11/  22.
  HC  BCKGRD METER/RANGE/PPM                  3.4/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                 28.9/13/  27.
  CO  BCKGRD METER/RANGE/PPM                  .3/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                 47.8/ 3/  .82
  CO2 BCKGRD METER/RANGE/PCT                  2.5/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 32.1/ 2/  32.
  NOX BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                               16.15
  HC  CONCENTRATION PPM                          19.
  CO  CONCENTRATION PPM                          26.
  CO2 CONCENTRATION PCT                          .79
  NOX CONCENTRATION PPM                         31.6
  HC  MASS GRAMS                                 3.49
  CO  MASS GRAMS                                 9.49
  CO2 MASS GRAMS                              4610.0
  NOX MASS GRAMS                                17.35
  RUN TIME                  SECONDS            1200.
      DFC, WET (DRY)                          .938 ( .927)
      SCF, WET (DRY)                         1.000 ( .981)
      VOL (SCM)                                319.1
      SAM BLR (SCM)                            68.73
      KM  (MEASURED)                           20.51

  TEST NUMBER,                                1A2S40
  BAROMETER,               MM HG               741.9
  HUMIDITY,                G/KG                  7.3
  TEMPERATURE,             DEG C                25.0
   CARBON DIOXIDE,          G/KM               161.7
  FUEL CONSUMPTION,        L/100KM              6.04

  HYDROCARBONS,            G/KM                  .12
  CARBON MONOXIDE,         G/KM                  .33
  OXIDES OF NITROGEN,      G/KM                  .61
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APPENDIX C

TEST RESULTS,
FIAT NATURALLY-ASPIRATED DIESEL
WITH CATALYTIC TRAP
FUELS EM-329-F AND EM-469-F

SUMMARY OF REGULATED EMISSIONS FROM FIAT NATURALLY-ASPIRATED DIESEL RESEARCH VEHICLE, EM-329-F BASE FUEL, WITH CATALYTIC TRAP

Test Code Test Type Date (1981) Run No.	1B1F46 3-b FTP 4/6 1	1B1F50 3-b FTP 4/7 2	1B1F54 3-b FTP 4/9 3	1B1F58 3-B FTP 4/10 4	1B1H47 HFET 4/6 1	1B1H51 HFET 4/7 2	1B1H55 HFET 4/9 3	1B1H59 HFET 4/10 4
HC, g/mi	0.06	0.06	0.10	0.08	0.02	0.02	0.02	0.02
CO, g/mi	0.27	0.31	0.35	0.23	0.05	0.06	0.06	0.03
NO$_x$, g/mi	1.40	1.46	1.51	1.54	1.08	1.11	1.11	1.09
Particulate, g/mi	0.13	0.11	0.09	0.10	0.06	0.07	0.09	0.12
Fuel, mi/gal	28.2	28.9	27.7	28.1	38.5	38.3	37.0	37.8

Test Code Test Type Date (1981) Run No.	1B1N48 NYCC 4/6 1	1B1N52 NYCC 4/7 2	1B1N56 NYCC 4/9 3	1B1N60 NYCC 4/10 4	1B1S49 85 kph 4/6 1	1B1S53 85 kph 4/7 2	1B1S57 85 kph 4/9 3	1B1S61 85 kph 4/10 4
HC, g/mi	0.06	0.00	0.03	0.08	0.00	0.00	0.00	0.00
CO, g/mi	0.13	0.16	0.24	0.08	0.02	0.03	0.05	0.00
NO$_x$, g/mi	2.32	2.38	2.43	2.32	1.05	1.09	1.16	1.14
Particulate, g/mi	0.51	0.22	0.17	0.53	0.06	0.10	0.16	0.16
Fuel, mi/gal	17.2	19.0	17.3	18.8	39.1	39.4	36.6	38.6

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                                              FTP    VEHICLE EMISSIONS RESULTS
                                                       PROJECT 11-4874-001

TEST NO.   1B1F46   RUN   1                   VEHICLE NO.1D                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL     / NA FIAT CAT               DATE    4/ 6/81                        ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO. 1 / CVS NO.  3            DIESEL     EM-329-F
TRANSMISSION M5                               DYNO NO.      2                        ODOMETER 10892. KM( 6768. MILES)

BAROMETER 750.32 MM HG(29.54 IN HG)           DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  27. PCT                    ABS. HUMIDITY  5.3 GM/KG
BAG RESULTS                                                                          NOX HUMIDITY CORRECTION FACTOR   .85
  BAG NUMBER                                       1                  2                  3                  4
  DESCRIPTION                               COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)              716.3 (28.2)        721.4 (28.4)        716.3 (28.2)        721.4 (28.4)
  BLOWER INLET P MM. H2O(IN. H2O)            579.1 (22.8)        584.2 (23.0)        579.1 (22.8)        584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)        32.2 ( 90.0)        36.1 ( 97.0)        33.9 ( 93.0)
  BLOWER REVOLUTIONS                            13866.              23809.              13870.              23801.
  TOT FLOW STD. CU. METRES(SCF)              137.9 ( 4869.)      238.0 ( 8403.)      137.7 ( 4861.)      237.0 ( 8370.)
  HC  SAMPLE METER/RANGE/PPM                 10.2/11/  10.        4.6/11/   5.        7.1/11/   7.        5.0/11/   5.
  HC  BCKGRD METER/RANGE/PPM                  4.0/ 1/   4.        4.0/ 1/   4.        4.0/ 1/   4.        4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                 19.1/13/  17.        2.1/13/   2.        5.5/13/   5.        1.0/13/   1.
  CO  BCKGRD METER/RANGE/PPM                   .3/13/   0.         .2/13/   0.         .2/13/   0.         .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                 33.5/ 3/  .56       21.7/ 3/  .35       30.9/ 3/  .51       21.7/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT                  2.9/ 3/  .04        2.7/ 3/  .04        3.1/ 3/  .05        3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 21.1/ 2/  21.       15.1/ 2/  15.       19.8/ 2/  20.       15.1/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                   .1/ 2/   0.         .1/ 2/   0.         .3/ 2/   0.         .3/ 2/   0.
  DILUTION FACTOR                               23.88               38.15               26.13               38.15
  HC  CONCENTRATION PPM                          6.                  1.                  3.                  1.
  CO  CONCENTRATION PPM                         17.                  2.                  5.                  1.
  CO2 CONCENTRATION PCT                          .52                 .31                 .47                 .30
  NOX CONCENTRATION PPM                        21.0                15.0                19.5                14.8
  HC  MASS GRAMS                                 .50                 .10                 .26                 .15
  CO  MASS GRAMS                                2.69                 .47                 .75                 .22
  CO2 MASS GRAMS                             1302.6              1352.5              1174.7              1308.0
  NOX MASS GRAMS                                4.70                5.80                4.36                5.70
  PARTICULATE MASS GRAMS                         .66                 .37                 .49                0.00

  HC  GRAMS/KM                                   .09                 .02                 .04                 .02
  CO  GRAMS/KM                                   .48                 .08                 .13                 .04
  CO2 GRAMS/KM                                234.1               220.5               205.3               213.0
  NOX GRAMS/KM                                   .85                 .95                 .76                 .93
  FUEL CONSUMPTION BY CB L/100KM                8.94                8.39                7.82                8.10

  RUN TIME               SECONDS               505.                867.                505.                867.
  MEASURED DISTANCE      KM                    5.56                6.13                5.72                6.14
  SCF, DRY                                     .986                .988                .987                .988
       DFC, WET (DRY)                                  .968 ( .960)                            .969 ( .961)
       SCF, WET (DRY)                                 1.000 ( .987)                           1.000 ( .988)
       VOL (SCM)                                             375.9                                   374.7
       SAM BLR (SCM)                                          80.17                                   80.14
       KM  (MEASURED)                                         11.70                                   11.86
       FUEL CONSUMPTION L/100KM                                8.65                                    7.96

COMPOSITE RESULTS
  TEST NUMBER               1B1F46                                                            3-BAG      (4-BAG)
  BAROMETER      MM HG      750.3                 CARBON DIOXIDE          G/KM                219.1      ( 216.9)
  HUMIDITY       G/KG         5.3                 FUEL CONSUMPTION        L/100KM               8.34     (  8.26)
  TEMPERATURE    DEG C       25.0                 HYDROCARBONS (THC)      G/KM                  .04      (   .04)
                                                  CARBON MONOXIDE         G/KM                  .17      (   .16)
                                                  OXIDES OF NITROGEN      G/KM                  .87      (   .87)
                                                  PARTICULATES            G/KM                  .079     ( 0.000)
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                                      HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B1H47   RUN   1                    VEHICLE NO.1B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                DATE    4/ 6/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                   DIESEL    EM-329-F
TRANSMISSION M5                                DYNO NO.      2                   ODOMETER 10913  KM( 6782  MILES)
                                               CVS NO.   3

BAROMETER 748.28 MM HG(29.46 IN HG)            DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  28. PCT                     ABS. HUMIDITY  5.7 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .86
BAG RESULTS
  TEST CYCLE                                     HFET

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             20998.
  TOT FLOW STD. CU. METRES(SCF)               207.5 ( 7328.)
  HC  SAMPLE METER/RANGE/PPM                  5.1/11/   5.
  HC  BCKGRD METER/RANGE/PPM                  4.1/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                  2.3/13/   2.
  CO  BCKGRD METER/RANGE/PPM                   .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                 43.2/ 3/  .74
  CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 32.4/ 2/  32.
  NOX BCKGRD METER/RANGE/PPM                   .3/ 2/   0.
  DILUTION FACTOR                                18.15
  HC  CONCENTRATION PPM                             1.
  CO  CONCENTRATION PPM                             2.
  CO2 CONCENTRATION PCT                            .69
  NOX CONCENTRATION PPM                           32.1
  HC  MASS GRAMS                                   .15
  CO  MASS GRAMS                                   .47
  CO2 MASS GRAMS                                2620.9
  NOX MASS GRAMS                                 10.94
  PARTICULATE MASS GRAMS                           .59
  RUN TIME                 SECONDS                765.
       DFC, WET (DRY)                         .945 ( .936)
       SCF, WET (DRY)                        1.000 ( .984)
       VOL (SCM)                                 207.5
       SAM BLR (SCM)                             44.57
       KM  (MEASURED)                            16.32

  TEST NUMBER,                                  1B1H47
  BAROMETER,             MM HG                   748.3
  HUMIDITY,              G/KG                      5.7
  TEMPERATURE,           DEG C                    25.6
   CARBON DIOXIDE,        G/KM                   160.6
  FUEL CONSUMPTION,      L/100KM                  6.11

  HYDROCARBONS,          G/KM                      .01
  CARBON MONOXIDE,       G/KM                      .03
  OXIDES OF NITROGEN,    G/KM                      .67
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 11-4874-001

TEST NO.   1B1N48   RUN   1                   VEHICLE NO.1B                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT.               DATE    4/ 6/81                      ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                      DIESEL    EM-329-F
TRANSMISSION M5                               DYNO NO.      2                      ODOMETER 10931. KM( 6792. MILES)
                                              CVS NO.   3

BAROMETER 747.52 MM HG(29.43 IN HG)           DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  28. PCT                    ABS. HUMIDITY  6.1 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .87
BAG RESULTS
  TEST CYCLE                                    NYCC

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.2 ( 99.0)
  BLOWER REVOLUTIONS                             16437.
  TOT FLOW STD. CU. METRES(SCF)               162.6 ( 5741.)
  HC  SAMPLE METER/RANGE/PPM                   4.8/11/   5.
  HC  BCKGRD METER/RANGE/PPM                   4.1/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                   1.0/13/   1.
  CO  BCKGRD METER/RANGE/PPM                    .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                  17.2/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                   3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  10.5/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                    .5/ 2/   1.
  DILUTION FACTOR                                 48.73
  HC  CONCENTRATION PPM                             1.
  CO  CONCENTRATION PPM                             1.
  CO2 CONCENTRATION PCT                            .23
  NOX CONCENTRATION PPM                           10.0
  HC  MASS GRAMS                                   .08
  CO  MASS GRAMS                                   .15
  CO2 MASS GRAMS                                 674.1
  NOX MASS GRAMS                                  2.70
  PARTICULATE MASS GRAMS                           .60
  RUN TIME               SECONDS                 599.
       DFC, WET (DRY)                         .979 ( .970)
       SCF, WET (DRY)                        1.000 ( .988)
       VOL (SCM)                                 162.6
       SAM BLR (SCM)                             34.86
       KM  (MEASURED)                             1.88

  TEST NUMBER,                                  1B1N48
  BAROMETER,             MM HG                   747.5
  HUMIDITY,              G/KG                      6.1
  TEMPERATURE,           DEG C                    26.1
   CARBON DIOXIDE,        G/KM                   359.1
  FUEL CONSUMPTION,      L/100KM                 13.66

  HYDROCARBONS,          G/KM                      .04
  CARBON MONOXIDE,       G/KM                      .08
  OXIDES OF NITROGEN,    G/KM                     1.44
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                                         85 KPH VEHICLE EMISSIONS RESULTS
                                              PROJECT 11-4874-001

TEST NO.    1D1S49    RUN    1                VEHICLE NO.1B                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        NA FIAT CAT              DATE      4/ 6/81                      ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                        DIESEL      EM-329-F
TRANSMISSION M5                               DYNO NO.      2                        ODOMETER 10935  KM( 6795  MILES)
                                              CVS NO.    3

BAROMETER 747.27 MM HG(29.42 IN HG)           DRY BULB TEMP. 27.8 DEG C(82.0 DEG F)
RELATIVE HUMIDITY  25. PCT                    ABS. HUMIDITY  6.0 GM/KG
BAG RESULTS                                                                          NOX HUMIDITY CORRECTION FACTOR    .87
  TEST CYCLE                                     85 K

  BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)             574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             32934.
  TOT FLOW STD. CU. METRES(SCF)               324.8 (11468.)
  HC  SAMPLE METER/RANGE/PPM                   4.0/11/    4.
  HC  BCKGRD METER/RANGE/PPM                   4.6/ 1/    5.
  CO  SAMPLE METER/RANGE/PPM                   1.1/13/    1.
  CO  BCKGRD METER/RANGE/PPM                    .1/13/    0.
  CO2 SAMPLE METER/RANGE/PCT                  46.4/ 3/   .80
  CO2 BCKGRD METER/RANGE/PCT                   2.8/ 3/   .04
  NOX SAMPLE METER/RANGE/PPM                  34.7/ 2/   35.
  NOX BCKGRD METER/RANGE/PPM                    .4/ 2/    0.
  DILUTION FACTOR                                16.78
  HC  CONCENTRATION PPM                            -0.
  CO  CONCENTRATION PPM                             1.
  CO2 CONCENTRATION PCT                            .76
  NOX CONCENTRATION PPM                           34.3
  HC  MASS GRAMS                                  -.06
  CO  MASS GRAMS                                   .33
  CO2 MASS GRAMS                                4506.6
  NOX MASS GRAMS                                 18.47
  PARTICULATE MASS GRAMS                           .99
  RUN TIME              SECONDS                1200.
       DFC, WET (DRY)                         .940 ( .933)
       SCF, WET (DRY)                        1.000 ( .984)
       VOL (SCM)                               324.8
       SAM BLR (SCM)                           69.73
       KM  (MEASURED)                          28.47

  TEST NUMBER,                                 1D1S49
  BAROMETER,             MM HG                 747.3
  HUMIDITY,              G/KG                    6.0
  TEMPERATURE,           DEG C                  27.8
   CARBON DIOXIDE,        G/KM                  158.3
  FUEL CONSUMPTION,      L/100KM                6.02

  HYDROCARBONS,          G/KM                   -.00
  CARBON MONOXIDE,       G/KM                    .01
  OXIDES OF NITROGEN,    G/KM                    .65
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                                      FTP    VEHICLE EMISSIONS RESULTS
                                               PROJECT 11-4874-001

TEST NO.   1B1F50   RUN   2                  VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE    4/ 7/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO. 1 / CVS NO.  3        DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                    ODOMETER 10966. KM( 6814. MILES)

BAROMETER 738.89 MM HG(29.09 IN HG)          DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  49. PCT                   ABS. HUMIDITY 10.0 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  BAG NUMBER                                      1                 2                  3                 4
  DESCRIPTION                               COLD TRANSIENT      STABILIZED       HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             706.1 (27.8)       711.2 (28.0)      706.1 (27.8)       716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)       574.0 (22.6)      571.5 (22.5)       579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)       34.4 ( 94.0)      35.0 ( 95.0)       34.4 ( 94.0)
  BLOWER REVOLUTIONS                           13876.             23818.            13875.             23827.
  TOT FLOW STD. CU. METRES(SCF)             134.9 ( 4763.)     232.1 ( 8196.)    135.1 ( 4771.)     232.1 ( 8195.)
  HC  SAMPLE METER/RANGE/PPM                 8.2/11/   8.       4.1/11/   4.      6.1/11/   6.       4.1/11/   4.
  HC  BCKGRD METER/RANGE/PPM                 4.1/ 1/   4.       3.1/ 1/   3.      3.1/ 1/   3.       3.2/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                18.2/13/  17.       3.3/13/   3.      5.5/13/   5.       2.8/13/   3.
  CO  BCKGRD METER/RANGE/PPM                  .2/13/   0.        .3/13/   0.       .1/13/   0.        .2/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                34.3/ 3/  .57      21.8/ 3/  .35     30.0/ 3/  .50      21.0/ 3/  .34
  CO2 BCKGRD METER/RANGE/PCT                 2.6/ 3/  .04       2.6/ 3/  .04      2.8/ 3/  .04       2.7/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                19.9/ 2/  20.      14.4/ 2/  14.     19.1/ 2/  19.      14.9/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                  .3/ 2/   0.        .3/ 2/   0.      1.1/ 2/   1.       1.2/ 2/   1.
  DILUTION FACTOR                              23.29              37.96             26.98              39.49
  HC  CONCENTRATION PPM                         4.                 1.                3.                 1.
  CO  CONCENTRATION PPM                        16.                 3.                5.                 2.
  CO2 CONCENTRATION PCT                         .53                .31               .45                .30
  NOX CONCENTRATION PPM                        19.6               14.1              18.0               13.7
  HC  MASS GRAMS                                .33                .14               .24                .13
  CO  MASS GRAMS                               2.50                .72               .75                .62
  CO2 MASS GRAMS                             1321.1             1332.8            1124.1             1260.0
  NOX MASS GRAMS                               4.95               6.12              4.56               5.96
  PARTICULATE MASS GRAMS                        .52                .32               .41               0.00

  HC  GRAMS/KM                                  .06                .02               .04                .02
  CO  GRAMS/KM                                  .43                .12               .13                .10
  CO2 GRAMS/KM                                229.7              216.8             195.8              207.1
  NOX GRAMS/KM                                  .86               1.00               .79                .97
  FUEL CONSUMPTION BY CB L/100KM               8.76               8.25              7.46               7.88

  RUN TIME              SECONDS                505.               867.              505.               868.
  MEASURED DISTANCE     KM                     5.75               6.15              5.74               6.12
  SCF, DRY                                     .979               .981              .980               .981
       DFC, WET (DRY)                                 .968 ( .952)                          .970 ( .955)
       SCF, WET (DRY)                                1.000 ( .980)                         1.000 ( .980)
       VOL (SCM)                                           367.0                                 367.2
       SAM BLR (SCM)                                       76.91                                 76.92
       KM  (MEASURED)                                      11.90                                 11.86
       FUEL CONSUMPTION L/100KM                             8.50                                  7.67

COMPOSITE RESULTS                                                                                3-BAG      (4-BAG)
  TEST NUMBER            1B1F50                             CARBON DIOXIDE         G/KM          213.7     ( 210.8)
  BAROMETER     MM HG     738.9                             FUEL CONSUMPTION       L/100KM        8.14     (  8.03)
  HUMIDITY      G/KG       10.0                             HYDROCARBONS (THC)     G/KM            .04     (   .04)
  TEMPERATURE   DEG C      25.0                             CARBON MONOXIDE        G/KM            .19     (   .18)
                                                            OXIDES OF NITROGEN     G/KM            .91     (   .91)
                                                            PARTICULATES           G/KM           .066     ( 0.000)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.    1B1H51    RUN   2               VEHICLE NO.1B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        NA FIAT CAT            DATE     4/ 7/81               ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.      2                ODOMETER 10989. KM( 6828. MILES)
                                            CVS NO.   3

BAROMETER 738.12 MM HG(29.06 IN HG)         DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  44. PCT                  ABS. HUMIDITY  9.6 GM/KG       NOX HUMIDITY CORRECTION FACTOR    .96
BAG RESULTS
   TEST CYCLE                                  HFET

   BLOWER DIF P MM. H2O(IN. H2O)            711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)          571.5 (22.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)         37.2 ( 99.0)
   BLOWER REVOLUTIONS                          21015.
   TOT FLOW STD. CU. METRES(SCF)            203.5 ( 7186.)
   HC  SAMPLE METER/RANGE/PPM                4.7/11/   5.
   HC  BCKGRD METER/RANGE/PPM                3.5/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM                3.1/13/   3.
   CO  BCKGRD METER/RANGE/PPM                 .1/13/   0.
   CO2 SAMPLE METER/RANGE/PCT               44.1/ 3/  .75
   CO2 BCKGRD METER/RANGE/PCT                3.1/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM               31.1/ 2/  31.
   NOX BCKGRD METER/RANGE/PPM                1.0/ 2/   1.
   DILUTION FACTOR                             17.74
   HC  CONCENTRATION PPM                          1.
   CO  CONCENTRATION PPM                          3.
   CO2 CONCENTRATION PCT                         .71
   NOX CONCENTRATION PPM                        30.2
   HC  MASS GRAMS                                .17
   CO  MASS GRAMS                                .62
   CO2 MASS GRAMS                             2644.6
   NOX MASS GRAMS                              11.31
   PARTICULATE MASS GRAMS                        .69
   RUN TIME               SECONDS               765.
        DFC, WET (DRY)                      .944 ( .930)
        SCF, WET (DRY)                     1.000 ( .979)
        VOL (SCM)                              203.5
        SAM BLR (SCM)                          42.60
        KM  (MEASURED)                         16.39

   TEST NUMBER,                              1B1H51
   BARAMETER,             MM HG               738.1
   HUMIDITY,              G/KG                  9.6
   TEMPERATURE,           DEG C                26.1
    CARBON DIOXIDE,        G/KM               161.4
   FUEL CONSUMPTION,      L/100KM              6.14

   HYDROCARBONS,          G/KM                  .01
   CARBON MONOXIDE,       G/KM                  .04
   OXIDES OF NITROGEN,    G/KM                  .69
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B1N52   RUN   2                  VEHICLE NO.1B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE    4/ 7/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                DIESEL    EM-329-F
TRANSMISSION M5                              DYNO NO.      2                ODOMETER 11005. KM( 6838. MILES)
                                             CVS NO.   3

BAROMETER 737.87 MM HG(29.05 IN HG)          DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  44. PCT                   ABS. HUMIDITY  9.6 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)            569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)           34.4 ( 94.0)
  BLOWER REVOLUTIONS                           16456.
  TOT FLOW STD. CU. METRES(SCF)              160.0 ( 5650.)
  HC  SAMPLE METER/RANGE/PPM                 3.6/11/   4.
  HC  BCKGRD METER/RANGE/PPM                 3.9/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                 1.2/13/   1.
  CO  BCKGRD METER/RANGE/PPM                  .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                16.2/ 3/  .26
  CO2 BCKGRD METER/RANGE/PCT                 3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                10.5/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                 1.0/ 2/   1.
  DILUTION FACTOR                              51.90
  HC  CONCENTRATION PPM                        -0.
  CO  CONCENTRATION PPM                         1.
  CO2 CONCENTRATION PCT                         .21
  NOX CONCENTRATION PPM                        9.5
  HC  MASS GRAMS                               -.02
  CO  MASS GRAMS                                .18
  CO2 MASS GRAMS                              618.8
  NOX MASS GRAMS                               2.81
  PARTICULATE MASS GRAMS                        .26
  RUN TIME           SECONDS                  599.
      DFC, WET (DRY)                         .981 ( .967)
      SCF, WET (DRY)                        1.000 ( .983)
      VOL (SCM)                               160.0
      SAM BLR (SCM)                           33.35
      KM  (MEASURED)                           1.90

  TEST NUMBER,                               1B1N52
  BAROMETER,          MM HG                   737.9
  HUMIDITY,           G/KG                      9.6
  TEMPERATURE,        DEG C                    26.1
   CARBON DIOXIDE,    G/KM                    326.1
  FUEL CONSUMPTION,   L/100KM                 12.40

  HYDROCARBONS,       G/KM                     -.01
  CARBON MONOXIDE,    G/KM                      .10
  OXIDES OF NITROGEN, G/KM                     1.48
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1B1S53   RUN   2                    VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                DATE    4/ 7/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                    DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.      2                    ODOMETER 11008. KM( 6840. MILES)
                                               CVS NO.    3

BAROMETER 737.62 MM HG(29.04 IN HG)            DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  41. PCT                     ABS. HUMIDITY  9.3 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)                711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)              574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.8 (100.0)
  BLOWER REVOLUTIONS                             32963.
  TOT FLOW STD. CU. METRES(SCF)                318.6 (11249.)
  HC  SAMPLE METER/RANGE/PPM                    3.6/11/   4.
  HC  BCKGRD METER/RANGE/PPM                    4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                    2.1/13/   2.
  CO  BCKGRD METER/RANGE/PPM                     .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                   47.1/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT                    3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   33.9/ 2/  34.
  NOX BCKGRD METER/RANGE/PPM                     .7/ 2/   1.
  DILUTION FACTOR                                 16.50
  HC  CONCENTRATION PPM                           -0.
  CO  CONCENTRATION PPM                            2.
  CO2 CONCENTRATION PCT                           .77
  NOX CONCENTRATION PPM                          33.2
  HC  MASS GRAMS                                 - .02
  CO  MASS GRAMS                                   .65
  CO2 MASS GRAMS                               4464.5
  NOX MASS GRAMS                                 19.37
  PARTICULATE MASS GRAMS                          1.77
  RUN TIME                  SECONDS              1200.
      DFC, WET (DRY)                             .939 ( .927)
      SCF, WET (DRY)                            1.000 ( .979)
      VOL (SCM)                                  318.6
      SAM BLR (SCM)                               66.77
      KM  (MEASURED)                              28.41

  TEST NUMBER,                                  1B1S53
  BAROMETER,               MM HG                 737.6
  HUMIDITY,                G/KG                    9.3
  TEMPERATURE,             DEG C                  26.7
   CARBON DIOXIDE,          G/KM                 157.1
  FUEL CONSUMPTION,        L/100KM                5.97

  HYDROCARBONS,            G/KM                  -.00
  CARBON MONOXIDE,         G/KM                   .02
  OXIDES OF NITROGEN,      G/KM                   .68
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                                        FTP    VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B1F54   RUN   3                       VEHICLE NO.1B                                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                   DATE     4/ 9/81                               ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                        BAG CART NO. 1 / CVS NO.  3                    DIESEL     EM-329-F
TRANSMISSION M5                                   DYNO NO.      2                                ODOMETER 11051. KM( 6867. MILES)

BAROMETER 742.44 MM HG(29.23 IN HG)               DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  60. PCT                        ABS. HUMIDITY 12.7 GM/KG                       NOX HUMIDITY CORRECTION FACTOR  1.07
BAG RESULTS
  BAG NUMBER                                           1                  2                  3                  4
  DESCRIPTION                                    COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)                   711.2 (28.0)       711.2 (28.0)       711.2 (28.0)       711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)                 571.5 (22.5)       581.7 (22.9)       579.1 (22.8)       579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)                35.6 ( 96.0)       33.9 ( 93.0)       35.6 ( 96.0)       33.9 ( 93.0)
  BLOWER REVOLUTIONS                                13873.             23824.             13879.             23827.
  TOT FLOW STD. CU. METRES(SCF)                   136.1 ( 4806.)     234.2 ( 8271.)     136.1 ( 4805.)     234.3 ( 8273.)
  HC  SAMPLE METER/RANGE/PPM                      10.3/11/  10.       5.6/11/   6.       7.3/11/   7.       5.6/11/   6.
  HC  BCKGRD METER/RANGE/PPM                       3.9/ 1/   4.       3.7/ 1/   4.       3.7/ 1/   4.       3.9/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                      23.2/13/  21.       4.8/13/   4.       7.4/13/   7.       4.2/13/   4.
  CO  BCKGRD METER/RANGE/PPM                       1.5/13/   1.       1.4/13/   1.       1.3/13/   1.       1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                      35.9/ 3/  .60      22.7/ 3/  .37      31.3/ 3/  .52      22.4/ 3/  .36
  CO2 BCKGRD METER/RANGE/PCT                       3.2/ 3/  .05       3.0/ 3/  .05       3.3/ 3/  .05       3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                      19.0/ 2/  19.      13.8/ 2/  14.      17.2/ 2/  17.      13.5/ 2/  14.
  NOX BCKGRD METER/RANGE/PPM                        .6/ 2/   1.        .5/ 2/   1.        .5/ 2/   1.        .5/ 2/   1.
  DILUTION FACTOR                                    22.14              36.34              25.76              36.86
  HC  CONCENTRATION PPM                               7.                 2.                 4.                 2.
  CO  CONCENTRATION PPM                              19.                 3.                 5.                 3.
  CO2 CONCENTRATION PCT                               .56                .32                .47                .31
  NOX CONCENTRATION PPM                             18.4               13.3               16.7               13.0
  HC  MASS GRAMS                                      .52                .28                .30                .25
  CO  MASS GRAMS                                     3.05                .82                .85                .72
  CO2 MASS GRAMS                                   1383.9             1305.9             1171.7             1331.7
  NOX MASS GRAMS                                     5.13               6.37               4.65               6.23
  PARTICULATE MASS GRAMS                              .40                .32                .30               0.00

  HC  GRAMS/KM                                        .09                .04                .05                .04
  CO  GRAMS/KM                                        .53                .13                .15                .12
  CO2 GRAMS/KM                                      240.6              224.9              205.7              218.3
  NOX GRAMS/KM                                        .89               1.03                .82               1.02
  FUEL CONSUMPTION BY CB L/100KM                     9.19               8.56               7.83               8.31

  RUN TIME             SECONDS                       505.               868.               506.               868.
  MEASURED DISTANCE    KM                            5.75               6.16               5.70               6.10
  SCF, DRY                                           .975               .977               .976               .977
       DFC, WET (DRY)                                      .966 ( .947)                          .969 ( .950)
       SCF, WET (DRY)                                     1.000 ( .976)                         1.000 ( .977)
       VOL (SCM)                                                370.4                                 370.4
       SAM BLR (SCM)                                            70.57                                 78.56
       KM  (MEASURED)                                           11.91                                 11.80
       FUEL CONSUMPTION L/100KM                                  8.87                                  8.08

COMPOSITE RESULTS
  TEST NUMBER           1B1F54                                                                 3-BAG       (4-BAG)
  BAROMETER    MM HG    742.4                        CARBON DIOXIDE        G/KM               222.9       ( 220.9)
  HUMIDITY     G/KG      12.7                        FUEL CONSUMPTION      L/100KM              8.49      (   8.42)
  TEMPERATURE  DEG C     25.6                        HYDROCARBONS (THC)    G/KM                  .06      (    .06)
                                                     CARBON MONOXIDE       G/KM                  .22      (    .22)
                                                     OXIDES OF NITROGEN    G/KM                  .94      (    .94)
                                                     PARTICULATES          G/KM                 .056      ( 0.000)
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                                          HFET   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 11-4874-001

TEST NO.   1B1H55   RUN   3                  VEHICLE NO.1B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT               DATE     4/ 9/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                   DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                   ODOMETER 11074. KM( 6881. MILES)
                                             CVS NO.    3

BAROMETER 742.70 MM HG(29.24 IN HG)          DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  54. PCT                   ABS. HUMIDITY 11.7 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
   TEST CYCLE                                  HFET

   BLOWER DIF P MM. H2O(IN. H2O)             711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)          40.0 (104.0)
   BLOWER REVOLUTIONS                           21029.
   TOT FLOW STD. CU. METRES(SCF)             204.3 ( 7215.)
   HC  SAMPLE METER/RANGE/PPM                 5.5/11/   5.
   HC  BCKGRD METER/RANGE/PPM                 3.8/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM                 4.3/13/   4.
   CO  BCKGRD METER/RANGE/PPM                 1.1/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                45.2/ 3/  .78
   CO2 BCKGRD METER/RANGE/PCT                 3.3/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                28.7/ 2/  29.
   NOX BCKGRD METER/RANGE/PPM                  .7/ 2/   1.
   DILUTION FACTOR                              17.26
   HC  CONCENTRATION PPM                          2.
   CO  CONCENTRATION PPM                          3.
   CO2 CONCENTRATION PCT                          .73
   NOX CONCENTRATION PPM                        28.0
   HC  MASS GRAMS                                 .23
   CO  MASS GRAMS                                 .67
   CO2 MASS GRAMS                             2722.3
   NOX MASS GRAMS                               11.31
   PARTICULATE MASS GRAMS                         .96
   RUN TIME              SECONDS               766.
        DFC, WET (DRY)                        .942 ( .926)
        SCF, WET (DRY)                       1.000 ( .976)
        VOL (SCM)                               204.3
        SAM BLR (SCM)                           43.46
        KM  (MEASURED)                          16.30

   TEST NUMBER,                                1B1H55
   BAROMETER,            MM HG                  742.7
   HUMIDITY,             G/KG                    11.7
   TEMPERATURE,          DEG C                   26.1
    CARBON DIOXIDE,       G/KM                  167.0
   FUEL CONSUMPTION,     L/100KM                 6.35

   HYDROCARBONS,         G/KM                     .01
   CARBON MONOXIDE,      G/KM                     .04
   OXIDES OF NITROGEN,   G/KM                     .69
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B1N56   RUN   3                    VEHICLE NO.1B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                DATE    4/ 9/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                   DIESEL    EM-329-F
TRANSMISSION M5                                DYNO NO.      2                   ODOMETER 11090. KM( 6891. MILES)
                                               CVS NO.   3

BAROMETER 742.70 MM HG(29.24 IN HG)            DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  54. PCT                     ABS. HUMIDITY 12.2 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.05
BAG RESULTS
  TEST CYCLE                                      NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)              571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)             35.6 ( 96.0)
  BLOWER REVOLUTIONS                              16486.
  TOT FLOW STD. CU. METRES(SCF)                161.6 ( 5705.)
  HC   SAMPLE METER/RANGE/PPM                  4.9/11/    5.
  HC   BCKGRD METER/RANGE/PPM                  4.6/ 1/    5.
  CO   SAMPLE METER/RANGE/PPM                  2.5/13/    2.
  CO   BCKGRD METER/RANGE/PPM                   .8/13/    1.
  CO2  SAMPLE METER/RANGE/PCT                 17.5/ 3/   .28
  CO2  BCKGRD METER/RANGE/PCT                  3.4/ 3/   .05
  NOX  SAMPLE METER/RANGE/PPM                  9.4/ 2/    9.
  NOX  BCKGRD METER/RANGE/PPM                   .6/ 2/    1.
  DILUTION FACTOR                                 47.83
  HC   CONCENTRATION PPM                           0.
  CO   CONCENTRATION PPM                           2.
  CO2  CONCENTRATION PCT                          .23
  NOX  CONCENTRATION PPM                          8.8
  HC   MASS GRAMS                                  .04
  CO   MASS GRAMS                                  .28
  CO2  MASS GRAMS                               675.8
  NOX  MASS GRAMS                                 2.86
  PARTICULATE MASS GRAMS                           .20
  RUN TIME              SECONDS                  600.
       DFC, WET (DRY)                          .979 ( .962)
       SCF, WET (DRY)                         1.000 ( .980)
       VOL (SCM)                                161.6
       SAM BLR (SCM)                             34.14
       KM  (MEASURED)                             1.89

  TEST NUMBER,                                 1B1N56
  BAROMETER,            MM HG                   742.7
  HUMIDITY,             G/KG                     12.2
  TEMPERATURE,          DEG C                    26.7
   CARBON DIOXIDE,       G/KM                   356.8
  FUEL CONSUMPTION,     L/100KM                 13.57

  HYDROCARBONS,         G/KM                      .02
  CARBON MONOXIDE,      G/KM                      .15
  OXIDES OF NITROGEN,   G/KM                     1.51
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                                     85 KPH VEHICLE EMISSIONS RESULTS
                                         PROJECT 11-4874-001

TEST NO.   1B1S57   RUN   3              VEHICLE NO.1B
VEHICLE MODEL       NA FIAT CAT          DATE    4/ 9/81                  TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4               BAG CART NO.  1                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                          DYNO NO.      2                  DIESEL     EM-329-F
                                         CVS NO.   3                      ODOMETER 11092. KM( 6892. MILES)

BAROMETER 742.70 MM HG(29.24 IN HG)      DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  51. PCT               ABS. HUMIDITY 11.4 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
   TEST CYCLE                               85 K

  BLOWER DIF P MM. H2O(IN. H2O)           711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)         571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        40.6 (105.0)
  BLOWER REVOLUTIONS                        32397.
  TOT FLOW STD. CU. METRES(SCF)           314.2 (11095.)
  HC  SAMPLE METER/RANGE/PPM               5.2/11/   5.
  HC  BCKGRD METER/RANGE/PPM               6.5/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM               3.1/13/   3.
  CO  BCKGRD METER/RANGE/PPM                .8/13/   1.
  CO2 SAMPLE METER/RANGE/PCT              50.2/ 3/  .87
  CO2 BCKGRD METER/RANGE/PCT               3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM              33.7/ 2/  34.
  NOX BCKGRD METER/RANGE/PPM                .8/ 2/   1.
  DILUTION FACTOR                           15.37
  HC  CONCENTRATION PPM                      -1.
  CO  CONCENTRATION PPM                       2.
  CO2 CONCENTRATION PCT                      .82
  NOX CONCENTRATION PPM                     33.0
  HC  MASS GRAMS                            -.15
  CO  MASS GRAMS                             .75
  CO2 MASS GRAMS                          4730.3
  NOX MASS GRAMS                           20.27
  PARTICULATE MASS GRAMS                    2.72
  RUN TIME              SECONDS            1100.
      DFC, WET (DRY)                      .935 ( .920)
      SCF, WET (DRY)                     1.000 ( .976)
      VOL (SCM)                            314.2
      SAM BLR (SCM)                        66.80
      KM  (MEASURED)                       27.99

  TEST NUMBER,                            1B1S57
  BAROMETER,             MM HG             742.7
  HUMIDITY,              G/KG               11.4
  TEMPERATURE,           DEG C              26.7
   CARBON DIOXIDE,        G/KM             169.0
  FUEL CONSUMPTION,      L/100KM            6.42

  HYDROCARBONS,          G/KM               -.01
  CARBON MONOXIDE,       G/KM                .03
  OXIDES OF NITROGEN,    G/KM                .72
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                                   FTP    VEHICLE EMISSIONS RESULTS
                                            PROJECT 11-4874-001

TEST NO.   1B1F58   RUN   4                 VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT             DATE    4/10/81                    ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO. 1 / CVS NO.  3        DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.     2                     ODOMETER 11124. KM( 6912. MILES)

BAROMETER 742.70 MM HG(29.24 IN HG)         DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  70. PCT                  ABS. HUMIDITY 12.9 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.08
BAG RESULTS
  BAG NUMBER                                    1               2                  3                4
  DESCRIPTION                             COLD TRANSIENT    STABILIZED        HOT TRANSIENT      STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)            711.2 (28.0)     716.3 (28.2)      711.2 (28.0)      716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)          571.5 (22.5)     574.0 (22.6)      571.5 (22.5)      574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)         35.6 ( 96.0)     33.9 ( 93.0)      36.1 ( 97.0)      35.0 ( 95.0)
  BLOWER REVOLUTIONS                         13865.           23812.            13874.            23814.
  TOT FLOW STD. CU. METRES(SCF)            135.8 ( 4795.)   233.8 ( 8257.)    135.8 ( 4794.)    233.4 ( 8241.)
  HC   SAMPLE METER/RANGE/PPM              10.1/11/  10.     6.0/11/   6.      7.7/11/   8.      5.4/11/   5.
  HC   BCKGRD METER/RANGE/PPM               5.0/ 1/   5.     4.4/ 1/   4.      4.4/ 1/   4.      4.1/ 1/   4.
  CO   SAMPLE METER/RANGE/PPM              28.3/13/  26.    10.6/13/  10.     10.2/13/   9.      5.8/13/   5.
  CO   BCKGRD METER/RANGE/PPM              12.1/13/  11.     9.6/13/   9.      5.7/13/   5.      4.7/13/   4.
  CO2  SAMPLE METER/RANGE/PCT              34.8/ 3/  .58    22.2/ 3/  .36     31.3/ 3/  .52     22.0/ 3/  .36
  CO2  BCKGRD METER/RANGE/PCT               3.0/ 3/  .05     2.8/ 3/  .04      3.2/ 3/  .05      3.2/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM              19.7/ 2/  20.    13.7/ 2/  14.     18.0/ 2/  18.     13.5/ 2/  14.
  NOX  BCKGRD METER/RANGE/PPM                .7/ 2/   1.      .5/ 2/   1.       .9/ 2/   1.       .4/ 2/   0.
  DILUTION FACTOR                             22.08            37.15             25.74             37.55
  HC   CONCENTRATION PPM                       5.               2.                3.                1.
  CO   CONCENTRATION PPM                      15.               1.                4.                1.
  CO2  CONCENTRATION PCT                        .54              .32               .47               .31
  NOX  CONCENTRATION PPM                      19.0             13.2              17.1              13.1
  HC   MASS GRAMS                               .42              .23               .27               .20
  CO   MASS GRAMS                              2.35              .29               .65               .28
  CO2  MASS GRAMS                            1338.1           1359.4            1172.7            1316.4
  NOX  MASS GRAMS                              5.32             6.36              4.79              6.30
  PARTICULATE MASS GRAMS                        .39              .33               .44              0.00

  HC   GRAMS/KM                                 .07              .04               .05               .03
  CO   GRAMS/KM                                 .41              .05               .11               .05
  CO2  GRAMS/KM                               233.1            221.7             205.1             214.7
  NOX  GRAMS/KM                                 .93             1.04               .84              1.03
  FUEL CONSUMPTION BY CB L/100KM               8.89             8.43              7.81              8.17

  RUN TIME              SECONDS              505.              867.              505.              868.
  MEASURED DISTANCE     KM                     5.74             6.13              5.72              6.13
  SCF, DRY                                     .972             .974              .973              .974
     DFC, WET (DRY)                                 .967 ( .945)                       .969 ( .947)
     SCF, WET (DRY)                                1.000 ( .973)                      1.000 ( .974)
     VOL (SCM)                                            369.6                              369.2
     SAM BLR (SCM)                                         77.76                              77.78
     KM  (MEASURED)                                        11.87                              11.85
     FUEL CONSUMPTION L/100KM                               8.66                               7.99

COMPOSITE RESULTS                                                                          3-BAG      (4-BAG)
  TEST NUMBER           1B1F58                          CARBON DIOXIDE       G/KM          219.5      ( 217.4)
  BAROMETER     MM HG   742.7                           FUEL CONSUMPTION     L/100KM         8.36     (   8.28)
  HUMIDITY      G/KG     12.9                           HYDROCARBONS (THC)   G/KM             .05     (    .05)
  TEMPERATURE   DEG C    23.3                           CARBON MONOXIDE      G/KM             .14     (    .14)
                                                        OXIDES OF NITROGEN   G/KM             .96     (    .96)
                                                        PARTICULATES         G/KM            .063     ( 0.000)
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                                          HFET   VEHICLE EMISSIONS RESULTS
                                                   PROJECT 11-4874-001

TEST NO.   1B1H59   RUN   4                 VEHICLE NO.1B                TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT              DATE    4/10/81              ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1              DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.      2              ODOMETER 11148. KM( 6927. MILES)
                                            CVS NO.   3

BAROMETER 742.19 MM HG(29.22 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT                  ABS. HUMIDITY 11.2 GM/KG                   NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                  HFET

  BLOWER DIF P MM. H2O(IN. H2O)             721.4 (28.4)
  BLOWER INLET P MM. H2O(IN. H2O)           584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          41.1 (106.0)
  BLOWER REVOLUTIONS                            21016.
  TOT FLOW STD. CU. METRES(SCF)             203.5 ( 7187.)
  HC  SAMPLE METER/RANGE/PPM                 5.7/11/   6.
  HC  BCKGRD METER/RANGE/PPM                 4.1/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                 3.8/13/   3.
  CO  BCKGRD METER/RANGE/PPM                 2.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                44.7/ 3/  .77
  CO2 BCKGRD METER/RANGE/PCT                 3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                28.5/ 2/  29.
  NOX BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                               17.48
  HC  CONCENTRATION PPM                           2.
  CO  CONCENTRATION PPM                           1.
  CO2 CONCENTRATION PCT                          .72
  NOX CONCENTRATION PPM                         28.0
  HC  MASS GRAMS                                 .22
  CO  MASS GRAMS                                 .25
  CO2 MASS GRAMS                              2665.7
  NOX MASS GRAMS                               11.07
  PARTICULATE MASS GRAMS                        1.21
  RUN TIME             SECONDS                  766.
       DFC, WET (DRY)                        .943 ( .927)
       SCF, WET (DRY)                       1.000 ( .976)
       VOL (SCM)                               203.5
       SAM BLR (SCM)                           43.69
       KM  (MEASURED)                          16.30

  TEST NUMBER,                                1B1H59
  BAROMETER,             MM HG                 742.2
  HUMIDITY,              G/KG                   11.2
  TEMPERATURE,           DEG C                  25.6
   CARBON DIOXIDE,        G/KM                 163.5
  FUEL CONSUMPTION,      L/100KM                6.22

  HYDROCARBONS,          G/KM                    .01
  CARBON MONOXIDE,       G/KM                    .02
  OXIDES OF NITROGEN,    G/KM                    .68
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.    1B1N60   RUN   4                   VEHICLE NO.1B                   TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                DATE     4/10/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                 DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.      2                 ODOMETER 11164. KM( 6937. MILES)
                                               CVS NO.   3

BAROMETER 742.19 MM HG(29.22 IN HG)            DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  66. PCT                     ABS. HUMIDITY 12.1 GM/KG        NOX HUMIDITY CORRECTION FACTOR  1.05
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)              571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.8 (100.0)
  BLOWER REVOLUTIONS                              16452.
  TOT FLOW STD. CU. METRES(SCF)                160.8 ( 5679.)
  HC  SAMPLE METER/RANGE/PPM                    4.9/11/   5.
  HC  BCKGRD METER/RANGE/PPM                    4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                    2.3/13/   2.
  CO  BCKGRD METER/RANGE/PPM                    1.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                   16.6/ 3/  .26
  CO2 BCKGRD METER/RANGE/PCT                    3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    9.1/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                     .6/ 2/   1.
  DILUTION FACTOR                                 50.55
  HC  CONCENTRATION PPM                             1.
  CO  CONCENTRATION PPM                             1.
  CO2 CONCENTRATION PCT                            .21
  NOX CONCENTRATION PPM                            8.5
  HC  MASS GRAMS                                    .09
  CO  MASS GRAMS                                    .10
  CO2 MASS GRAMS                                  628.3
  NOX MASS GRAMS                                   2.75
  PARTICULATE MASS GRAMS                            .63
  RUN TIME              SECONDS                   599.
       DFC, WET (DRY)                          .980 ( .959)
       SCF, WET (DRY)                         1.000 ( .976)
       VOL (SCM)                                  160.8
       SAM BLR (SCM)                              34.24
       KM  (MEASURED)                              1.91

  TEST NUMBER,                                   1B1N60
  BARONETER,            MM HG                     742.2
  HUMIDITY,             G/KG                       12.1
  TEMPERATURE,          DEG C                      23.3
   CARBON DIOXIDE,       G/KM                     329.2
  FUEL CONSUMPTION,     L/100KM                   12.52

  HYDROCARBONS,         G/KM                        .05
  CARBON MONOXIDE,      G/KM                        .05
  OXIDES OF NITROGEN,   G/KM                       1.44
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                                   85 KPH VEHICLE EMISSIONS RESULTS
                                        PROJECT 11-4874-001

TEST NO.   1B1S61    RUN    4               VEHICLE NO.1B                   TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT             DATE     4/10/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                 DIESEL     EM-329-F
TRANSMISSION M5                             DYNO NO.      2                 ODOMETER 11166. KM( 6938. MILES)
                                            CVS NO.   3

BAROMETER 742.19 MM HG(29.22 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  57. PCT                  ABS. HUMIDITY 11.9 GM/KG        NOX HUMIDITY CORRECTION FACTOR  1.04
BAG RESULTS
  TEST CYCLE                                  85 K

  BLOWER DIF P MM. H2O(IN. H2O)             711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)           579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)          41.1 (106.0)
  BLOWER REVOLUTIONS                           32939.
  TOT FLOW STD. CU. METRES(SCF)             318.9 (11260.)
  HC  SAMPLE METER/RANGE/PPM                  4.5/11/   4.
  HC  BCKGRD METER/RANGE/PPM                  4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                  1.1/13/   1.
  CO  BCKGRD METER/RANGE/PPM                  1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 47.7/ 3/  .82
  CO2 BCKGRD METER/RANGE/PCT                  2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 32.3/ 2/  32.
  NOX BCKGRD METER/RANGE/PPM                   .5/ 2/   1.
  DILUTION FACTOR                               16.27
  HC  CONCENTRATION PPM                           1.
  CO  CONCENTRATION PPM                           0.
  CO2 CONCENTRATION PCT                          .78
  NOX CONCENTRATION PPM                         31.8
  HC  MASS GRAMS                                 .14
  CO  MASS GRAMS                                 .05
  CO2 MASS GRAMS                              4561.6
  NOX MASS GRAMS                               20.21
  PARTICULATE MASS GRAMS                        2.76
  RUN TIME               SECONDS               1200.
        DFC, WET (DRY)                       .939 ( .921)
        SCF, WET (DRY)                      1.000 ( .974)
        VOL (SCM)                              318.9
        SAM BLR (SCM)                          68.18
        KM  (MEASURED)                         28.42

  TEST NUMBER,                                1B1S61
  BAROMETER,             MM HG                 742.2
  HUMIDITY,              G/KG                   11.9
  TEMPERATURE,           DEG C                  25.6
   CARBON DIOXIDE,        G/KM                 160.5
  FUEL CONSUMPTION,      L/100KM                6.10

  HYDROCARBONS,          G/KM                    .00
  CARBON MONOXIDE,       G/KM                    .00
  OXIDES OF NITROGEN,    G/KM                    .71
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SUMMARY OF REGULATED EMISSIONS FROM FIAT NATURALLY ASPIRATED DIESEL RESEARCH VEHICLE, EM-469-F FUEL, WITH CATALYTIC TRAP

Test Code Test Type Date (1981) Run No.	1B2F64 3-b FTP 4/15 1	1B2F68 3-b FTP 4/16 2	1B2F72 3-b FTP 4/20 3	1B2F76 3-b FTP 4/21 4	1B2H65 HFET 4/15 1	1B2H69 HFET 4/16 2	1B2H73 HFET 4/20 3	1B2H77 HFET 4/21 4
HC, g/mi	0.08	0.08	0.11	0.11	0.03	0.03	0.03	0.03
CO, g/mi	0.35	0.39	0.48	0.42	0.05	0.08	0.10	0.05
NO_x, g/mi	1.51	1.56	1.61	1.69	1.14	1.16	1.19	1.14
Particulate, g/mi	0.08	0.05	0.07	0.06	0.07	0.06	0.05	0.06
Fuel, mi/gal	28.5	28.7	28.9	29.0	38.0	39.1	39.5	39.1

Test Code Test Type Date (1981) Run No.	1B2N66 NYCC 4/15 1	1B2N70 NYCC 4/16 2	1B2N74 NYCC 4/20 3	1B2N78 NYCC 4/21 4	1B2S67 85 kph 4/15 1	1B2S71 85 kph 4/16 2	1B2S75 85 pkh 4/20 3	1B2S79 85 pkh 4/21 4
HC, g/mi	0.05	0.08	--[a]	0.00	0.00	0.00	0.02	0.02
CO, g/mi	0.23	0.24	--[a]	0.14	0.00	0.00	0.05	0.02
NO_x, g/mi	2.25	2.27	--[a]	2.25	1.13	1.14	1.13	1.11
Particulate, g/mi	0.23	0.10	0.18	0.12	0.08	0.11	0.07	0.09
Fuel, mi/gal	18.5	18.6	--[a]	18.8	39.5	38.7	40.6	40.1

[a] Data not acceptable

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                                      FTP    VEHICLE EMISSIONS RESULTS
                                               PROJECT 11-4874-001

TEST NO.   1B2F64    RUN   1
VEHICLE MODEL        NA FIAT CAT          VEHICLE NO.1B                                TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                DATE     4/15/81                             ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                           BAG CART NO. 1 / CVS NO.  3                  DIESEL     EM-469-F
                                          DYNO NO.      2                              ODOMETER 11330. KM( 7040. MILES)

BAROMETER 749.55 MM HG(29.51 IN HG)       DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                ABS. HUMIDITY 10.5 GM/KG                     NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  BAG NUMBER                                    1                    2                       3                       4
  DESCRIPTION                            COLD TRANSIENT          STABILIZED            HOT TRANSIENT            STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)         716.3 (28.2)         711.2 (28.0)          716.3 (28.2)          721.4 (28.4)
   BLOWER INLET P MM. H2O(IN. H2O)       579.1 (22.8)         584.2 (23.0)          579.1 (22.8)          584.2 (23.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)      35.0 ( 95.0)         32.8 ( 91.0)          36.1 ( 97.0)          34.4 ( 94.0)
   BLOWER REVOLUTIONS                       13864.               23830.                13863.                23822.
   TOT FLOW STD. CU. METRES(SCF)         137.5 ( 4854.)       237.2 ( 8377.)        137.2 ( 4844.)        236.3 ( 8344.)
   HC  SAMPLE METER/RANGE/PPM             9.1/11/    9.        5.4/11/    5.         8.0/11/    8.         5.2/11/    5.
   HC  BCKGRD METER/RANGE/PPM             4.3/ 1/    4.        3.7/ 1/    4.         3.7/ 1/    4.         3.7/ 1/    4.
   CO  SAMPLE METER/RANGE/PPM            19.8/13/   18.        4.3/13/    4.         8.3/13/    7.         2.4/13/    2.
   CO  BCKGRD METER/RANGE/PPM              .9/13/    1.         .8/13/    1.          .3/13/    0.          .3/13/    0.
   CO2 SAMPLE METER/RANGE/PCT            35.3/ 3/  .59        23.0/ 3/  .37         30.7/ 3/  .51         22.2/ 3/  .36
   CO2 BCKGRD METER/RANGE/PCT             3.0/ 3/  .05         3.2/ 3/  .05          2.9/ 3/  .04          3.4/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM            22.3/ 2/  22.        15.8/ 2/  16.         19.4/ 2/  19.         14.8/ 2/  15.
   NOX BCKGRD METER/RANGE/PPM             1.8/ 2/   2.         1.8/ 2/   2.          1.6/ 2/   2.          1.5/ 2/   2.
   DILUTION FACTOR                           22.56                35.84                 26.29                 37.23
   HC  CONCENTRATION PPM                      5.                   2.                    4.                    2.
   CO  CONCENTRATION PPM                     17.                   3.                    7.                    2.
   CO2 CONCENTRATION PCT                      .55                  .33                   .47                   .31
   NOX CONCENTRATION PPM                    20.6                 14.1                  17.9                  13.3
   HC  MASS GRAMS                             .39                  .25                   .35                   .22
   CO  MASS GRAMS                            2.68                  .85                  1.12                   .51
   CO2 MASS GRAMS                          1377.4               1413.0                1169.2                1334.7
   NOX MASS GRAMS                            5.38                 6.34                  4.66                  5.99
   PARTICULATE MASS GRAMS                     .32                  .26                   .35                  0.00

   HC  GRAMS/KM                               .07                  .04                   .06                   .04
   CO  GRAMS/KM                               .46                  .14                   .19                   .08
   CO2 GRAMS/KM                             236.9                226.1                 201.5                 213.5
   NOX GRAMS/KM                               .93                 1.01                   .80                   .76
   FUEL CONSUMPTION BY CB L/100KM            8.03                 8.41                  7.50                  7.93

   RUN TIME                 SECONDS          505.                 868.                  505.                  868.
   MEASURED DISTANCE        KM               5.81                 6.25                  5.80                  6.25
   SCF, DRY                                  .978                 .980                  .978                  .980
        DFC, WET (DRY)                              .966 ( .950)                                .969 ( .953)
        SCF, WET (DRY)                             1.000 ( .979)                               1.000 ( .979)
        VOL (SCM)                                           374.7                                       373.5
        SAM BLR (SCM)                                        79.42                                       79.29
        KM  (MEASURED)                                       12.06                                       12.05
        FUEL CONSUMPTION L/100KM                              8.61                                        7.73

COMPOSITE RESULTS                                                                                       3-BAG        (4-BAG)
  TEST NUMBER              1B2F64                                  CARBON DIOXIDE         G/KM          221.6        ( 217.9)
  BAROMETER      MM HG     749.6                                   FUEL CONSUMPTION       L/100KM         8.25       (  8.11)
  HUMIDITY       G/KG       10.5                                   HYDROCARBONS (THC)     G/KM            .05        (   .05)
  TEMPERATURE    DEG C      25.0                                   CARBON MONOXIDE        G/KM            .22        (   .20)
                                                                   OXIDES OF NITROGEN     G/KM            .94        (   .92)
                                                                   PARTICULATES           G/KM           .050        ( 0.000)
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                                   HFET   VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1B2H65   RUN   1                  VEHICLE NO.1B                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE     4/15/81                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                  DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                  ODOMETER 11352. KM( 7054. MILES)
                                             CVS NO.   3

BAROMETER 749.55 MM HG(29.51 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                   ABS. HUMIDITY 10.3 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
   TEST CYCLE                                   HFET

   BLOWER DIF P MM. H2O(IN. H2O)             711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)           576.6 (22.7)
   BLOWER INLET TEMP. DEG. C(DEG. F)          39.4 (103.0)
   BLOWER REVOLUTIONS                           21007.
   TOT FLOW STD. CU. METRES(SCF)             206.6 ( 7296.)
   HC  SAMPLE METER/RANGE/PPM                 5.9/11/   6.
   HC  BCKGRD METER/RANGE/PPM                 4.0/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM                 2.7/13/   2.
   CO  BCKGRD METER/RANGE/PPM                  .1/13/   0.
   CO2 SAMPLE METER/RANGE/PCT                45.0/ 3/  .77
   CO2 BCKGRD METER/RANGE/PCT                 3.1/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                30.8/ 2/  31.
   NOX BCKGRD METER/RANGE/PPM                  .8/ 2/   1.
   DILUTION FACTOR                              17.35
   HC  CONCENTRATION PPM                          2.
   CO  CONCENTRATION PPM                          2.
   CO2 CONCENTRATION PCT                         .73
   NOX CONCENTRATION PPM                        30.0
   HC  MASS GRAMS                                .25
   CO  MASS GRAMS                                .55
   CO2 MASS GRAMS                             2749.5
   NOX MASS GRAMS                              11.71
   PARTICULATE MASS GRAMS   -                    .76
   RUN TIME              SECONDS                765.
        DFC, WET (DRY)                       .942 ( .927)
        SCF, WET (DRY)                      1.000 ( .977)
        VOL (SCM)                              206.6
        SAM DLR (SCM)                          44.14
        KM  (MEASURED)                         16.52

   TEST NUMBER,                                1B2H65
   BAROMETER,            MM HG                 749.6
   HUMIDITY,             G/KG                   10.3
   TEMPERATURE,          DEG C                  25.6
    CARBON DIOXIDE,       G/KM                 166.5
   FUEL CONSUMPTION,     L/100KM                6.19

   HYDROCARBONS,         G/KM                    .02
   CARBON MONOXIDE,      G/KM                    .03
   OXIDES OF NITROGEN,   G/KM                    .71
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                                    NYCC    VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4074-001

TEST NO.   1B2N66   RUN   1                  VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT               DATE    4/15/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                    ODOMETER 11368. KM( 7064. MILES)
                                             CVS NO.   3

BAROMETER 749.55 MM HG(29.51 IN HG)          DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                   ABS. HUMIDITY 10.5 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                    NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)            576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)
  BLOWER REVOLUTIONS                            16458.
  TOT FLOW STD. CU. METRES(SCF)              163.2 ( 5764.)
  HC  SAMPLE METER/RANGE/PPM                  4.7/11/    5.
  HC  BCKGRD METER/RANGE/PPM                  4.1/ 1/    4.
  CO  SAMPLE METER/RANGE/PPM                  1.7/13/    2.
  CO  BCKGRD METER/RANGE/PPM                   .1/13/    0.
  CO2 SAMPLE METER/RANGE/PCT                 17.1/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                  3.4/ 3/  .03
  NOX SAMPLE METER/RANGE/PPM                  9.6/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                   .9/ 2/   1.
  DILUTION FACTOR                               49.02
  HC  CONCENTRATION PPM                           1.
  CO  CONCENTRATION PPM                           1.
  CO2 CONCENTRATION PCT                          .22
  NOX CONCENTRATION PPM                          8.7
  HC  MASS GRAMS                                  .06
  CO  MASS GRAMS                                  .27
  CO2 MASS GRAMS                               662.7
  NOX MASS GRAMS                                2.71
  PARTICULATE MASS GRAMS                          .27
  RUN TIME            SECONDS                  600.
       DFC, WET (DRY)                        .980 ( .963)
       SCF, WET (DRY)                       1.000 ( .981)
       VOL (SCM)                              163.2
       SAM BLR (SCM)                          34.64
       KM  (MEASURED)                          1.93

  TEST NUMBER,                                1B2N66
  BAROMETER,           MM HG                  749.6
  HUMIDITY,            G/KG                    10.5
  TEMPERATURE,         DEG C                   25.0
   CARBON DIOXIDE,      G/KM                   342.5
  FUEL CONSUMPTION,    L/100KM                12.73

  HYDROCARBONS,        G/KM                     .03
  CARBON MONOXIDE,     G/KM                     .14
  OXIDES OF NITROGEN,  G/KM                    1.40
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                                          85 KPH VEHICLE EMISSIONS RESULTS
                                               PROJECT 11-4874-001

TEST NO.   1B2S67   RUN   1                  VEHICLE NO.1B                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE    4/15/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                  DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                  ODOMETER 11370. KM( 7065. MILES)
                                             CVS NO.   3

BAROMETER 749.30 MM HG(29.50 IN HG)          DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  50. PCT                   ADS. HUMIDITY 10.8 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                   85 K

  BLOWER DIF P MM. H2O(IN. H2O)              711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)            576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)           39.4 (103.0)
  BLOWER REVOLUTIONS                            32935.
  TOT FLOW STD. CU. METRES(SCF)              324.4 (11453.)
  HC  SAMPLE METER/RANGE/PPM                  3.7/11/   4.
  HC  BCKGRD METER/RANGE/PPM                  4.1/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                   .5/13/   0.
  CO  BCKGRD METER/RANGE/PPM                   .2/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                 46.9/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT                  2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 32.6/ 2/  33.
  NOX BCKGRD METER/RANGE/PPM                   .9/ 2/   1.
  DILUTION FACTOR                                16.58
  HC  CONCENTRATION PPM                           -0.
  CO  CONCENTRATION PPM                            0.
  CO2 CONCENTRATION PCT                           .77
  NOX CONCENTRATION PPM                          31.8
  HC  MASS GRAMS                                 -.03
  CO  MASS GRAMS                                  .10
  CO2 MASS GRAMS                               4549.0
  NOX MASS GRAMS                                19.75
  PARTICULATE MASS GRAMS                         1.34
  RUN TIME              SECONDS                1200.
      DFC, WET (DRY)                         .940 ( .924)
      SCF, WET (DRY)                        1.000 ( .976)
      VOL (SCM)                                 324.4
      SAM BLR (SCM)                             69.81
      KM  (MEASURED)                            28.38

  TEST NUMBER,                                1B2S67
  BAROMETER,            MM HG                  749.3
  HUMIDITY,             G/KG                    10.8
  TEMPERATURE,          DEG C                   26.1
   CARBON DIOXIDE,       G/KM                  160.3
  FUEL CONSUMPTION,     L/100KM                 5.95

  HYDROCARBONS,         G/KM                    -.00
  CARBON MONOXIDE,      G/KM                     .00
  OXIDES OF NITROGEN,   G/KM                     .70
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                                          FTP    VEHICLE EMISSIONS RESULTS
                                                   PROJECT 11-4874-001

TEST NO.   1B2F68   RUN   2                  VEHICLE NO.1B                            TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT               DATE    4/16/81                          ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO. 1 / CVS NO.  3              DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                          ODOMETER 11402. KM( 7085. MILES)

BAROMETER 748.54 MM HG(29.47 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  56. PCT                   ABS. HUMIDITY 11.8 GM/KG                 NOX HUMIDITY CORRECTION FACTOR  1.04
BAG RESULTS
  BAG NUMBER                                       1                  2                    3                  4
  DESCRIPTION                               COLD TRANSIENT        STABILIZED         HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)              716.3 (28.2)       721.4 (28.4)       716.3 (28.2)       721.4 (28.4)
  BLOWER INLET P MM. H2O(IN. H2O)            574.0 (22.6)       584.2 (23.0)       574.0 (22.6)       584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)           36.1 ( 97.0)       33.9 ( 93.0)       36.1 ( 97.0)       34.4 ( 94.0)
  BLOWER REVOLUTIONS                           13997.             23745.             13849.             23803.
  TOT FLOW STD. CU. METRES(SCF)              137.8 ( 4865.)     234.4 ( 8278.)     136.3 ( 4813.)     234.7 ( 8288.)
  HC  SAMPLE METER/RANGE/PPM                  9.2/11/   9.        6.6/11/   7.       9.3/11/   9.       6.7/11/   7.
  HC  BCKGRD METER/RANGE/PPM                  4.5/ 1/   5.        4.9/ 1/   5.       4.9/ 1/   5.       4.9/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 20.0/13/  18.        4.6/13/   4.      11.1/13/  10.       3.4/13/   3.
  CO  BCKGRD METER/RANGE/PPM                  1.5/13/   1.        1.2/13/   1.        .5/13/   0.        .6/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 34.5/ 3/  .58       22.7/ 3/  .37      31.2/ 3/  .52      21.9/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05        3.1/ 3/  .05       3.4/ 3/  .05       3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 20.9/ 2/  21.       14.5/ 2/  15.      18.4/ 2/  18.      14.0/ 2/  14.
  NOX BCKGRD METER/RANGE/PPM                  1.0/ 2/   1.         .7/ 2/   1.        .8/ 2/   1.        .9/ 2/   1.
  DILUTION FACTOR                               23.13              36.33              25.82              37.75
  HC  CONCENTRATION PPM                          5.                 2.                 5.                 2.
  CO  CONCENTRATION PPM                         16.                 3.                 9.                 2.
  CO2 CONCENTRATION PCT                          .53                .32                .47                .31
  NOX CONCENTRATION PPM                         19.9               13.8               17.6               13.1
  HC  MASS GRAMS                                  .39                .25                .36                .26
  CO  MASS GRAMS                                 2.63                .82               1.48                .67
  CO2 MASS GRAMS                              1332.6             1380.5             1165.5             1316.5
  NOX MASS GRAMS                                 5.45               6.42               4.76               6.11
  PARTICULATE MASS GRAMS                          .13                .21                .19               0.00

  HC  GRAMS/KM                                    .07                .04                .06                .04
  CO  GRAMS/KM                                    .46                .13                .26                .11
  CO2 GRAMS/KM                                 231.7              225.0              202.8              214.0
  NOX GRAMS/KM                                    .95               1.05                .83                .99
  FUEL CONSUMPTION BY CB L/100KM                 8.64               8.37               7.55               7.96

  RUN TIME               SECONDS               510.               865.               505.               867.
  MEASURED DISTANCE      KM                    5.75               6.14               5.75               6.15
  SCF, DRY                                     .976               .978               .977               .978
       DFC, WET (DRY)                                 .967 ( .949)                          .969 ( .951)
       SCF, WET (DRY)                                1.000 ( .978)                         1.000 ( .978)
       VOL (SCM)                                            372.2                                 371.0
       SAM BLR (SCM)                                        77.74                                 77.51
       KM  (MEASURED)                                       11.89                                 11.90
       FUEL CONSUMPTION L/100KM                              8.50                                  7.76
COMPOSITE RESULTS
  TEST NUMBER              1B2F68                                                              3-BAG        (4-BAG)
  BAROMETER       MM HG    748.5                      CARBON DIOXIDE         G/KM              220.3       ( 217.0)
  HUMIDITY        G/KG      11.8                      FUEL CONSUMPTION       L/100KM            8.20       (   8.08)
  TEMPERATURE     DEG C     25.6                      HYDROCARBONS (THC)     G/KM                .05       (    .05)
                                                      CARBON MONOXIDE        G/KM                .24       (    .23)
                                                      OXIDES OF NITROGEN     G/KM                .97       (    .95)
                                                      PARTICULATES           G/KM               .031       ( 0.000)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B2H69   RUN   2                     VEHICLE NO.1B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        NA FIAT CAT                DATE    4/16/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                   DIESEL     EM-469-F
TRANSMISSION M5                                 DYNO NO.      2                   ODOMETER 11425. KM( 7099. MILES)
                                                CVS NO.   3

BAROMETER 748.28 MM HG(29.46 IN HG)             DRY BULB TEMP. 22.8 DEG C(73.0 DEG F)
RELATIVE HUMIDITY  65. PCT                      ABS. HUMIDITY 11.5 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  TEST CYCLE                                       HFET

   BLOWER DIF P MM. H2O(IN. H2O)               711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)             571.5 (22.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)            35.6 ( 96.0)
   BLOWER REVOLUTIONS                             21007.
   TOT FLOW STD. CU. METRES(SCF)               207.0 ( 7309.)
   HC  SAMPLE METER/RANGE/PPM                   7.5/11/   7.
   HC  BCKGRD METER/RANGE/PPM                   4.9/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                   4.3/13/   4.
   CO  BCKGRD METER/RANGE/PPM                    .7/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                  43.1/ 3/  .74
   CO2 BCKGRD METER/RANGE/PCT                   3.0/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                  29.7/ 2/  30.
   NOX BCKGRD METER/RANGE/PPM                   1.0/ 2/   1.
   DILUTION FACTOR                                 18.19
   HC  CONCENTRATION PPM                             3.
   CO  CONCENTRATION PPM                             3.
   CO2 CONCENTRATION PCT                            .69
   NOX CONCENTRATION PPM                           28.8
   HC  MASS GRAMS                                   .34
   CO  MASS GRAMS                                   .76
   CO2 MASS GRAMS                                2623.5
   NOX MASS GRAMS                                 11.70
   PARTICULATE MASS GRAMS                           .59
   RUN TIME                 SECONDS                765.
       DFC, WET (DRY)                          .945 ( .925)
       SCF, WET (DRY)                         1.000 ( .972)
       VOL (SCM)                                  207.0
       SAM BLR (SCM)                              43.29
       KM  (MEASURED)                             16.21

   TEST NUMBER,                                  1B2H69
   BAROMETER,              MM HG                  748.3
   HUMIDITY,               G/KG                    11.5
   TEMPERATURE,            DEG C                   22.8
    CARBON DIOXIDE,         G/KM                  161.9
   FUEL CONSUMPTION,       L/100KM                 6.02

   HYDROCARBONS,           G/KM                     .02
   CARBON MONOXIDE,        G/KM                     .05
   OXIDES OF NITROGEN,     G/KM                     .72
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 11-4874-001

TEST NO.   1B2N70   RUN   2                    VEHICLE NO.1B
VEHICLE MODEL       NA FIAT CAT                DATE     4/16/81                TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                DYNO NO.      2                 DIESEL     EM-469-F
                                               CVS NO.    3                    ODOMETER 11441. KM( 7109. MILES)

BAROMETER 748.03 MM HG(29.45 IN HG)            DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  46. PCT                     ABS. HUMIDITY  9.6 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .97
BAG RESULTS
  TEST CYCLE                                      NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)              574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)             35.6 ( 96.0)
  BLOWER REVOLUTIONS                             16452.
  TOT FLOW STD. CU. METRES(SCF)                162.0 ( 5721.)
  HC  SAMPLE METER/RANGE/PPM                    5.5/11/   5.
  HC  BCKGRD METER/RANGE/PPM                    4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                    1.9/13/   2.
  CO  BCKGRD METER/RANGE/PPM                     .1/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                   17.0/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                    3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   10.1/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                    1.0/ 2/   1.
  DILUTION FACTOR                                 49.30
  HC  CONCENTRATION PPM                              1.
  CO  CONCENTRATION PPM                              2.
  CO2 CONCENTRATION PCT                             .22
  NOX CONCENTRATION PPM                             9.1
  HC  MASS GRAMS                                    .10
  CO  MASS GRAMS                                    .30
  CO2 MASS GRAMS                                  657.3
  NOX MASS GRAMS                                   2.73
  PARTICULATE MASS GRAMS                            .12
  RUN TIME               SECONDS                  600.
       DFC, WET (DRY)                          .980 ( .965)
       SCF, WET (DRY)                         1.000 ( .983)
       VOL (SCM)                                  162.0
       SAM BLR (SCM)                              33.92
       KM  (MEASURED)                              1.94

  TEST NUMBER,                                   1B2N70
  BARONETER,             MM HG                    748.0
  HUMIDITY,              G/KG                       9.6
  TEMPERATURE,           DEG C                     25.6
   CARBON DIOXIDE,        G/KM                    339.5
  FUEL CONSUMPTION,      L/100KM                  12.62

  HYDROCARBONS,          G/KM                       .05
  CARBON MONOXIDE,       G/KM                       .15
  OXIDES OF NITROGEN,    G/KM                      1.41
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 11-4874-001

TEST NO.   1B2S71   RUN   2                   VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      NA FIAT CAT                DATE    4/16/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION M5                               DYNO NO.      2                    ODOMETER 11442. KM( 7110. MILES)
                                              CVS NO.   3

BAROMETER 748.03 MM HG(29.45 IN HG)           DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  47. PCT                    ABS. HUMIDITY 10.1 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)               716.3 (28.2)
  BLOWER INLET P MM. H2O(IN. H2O)             579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             32947.
  TOT FLOW STD. CU. METRES(SCF)               323.4 (11421.)
  HC   SAMPLE METER/RANGE/PPM                  4.8/11/   5.
  HC   BCKGRD METER/RANGE/PPM                  4.5/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                   .6/13/   1.
  CO   BCKGRD METER/RANGE/PPM                   .4/13/   0.
  CO2  SAMPLE METER/RANGE/PCT                 48.1/ 3/  .83
  CO2  BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                 34.0/ 2/  34.
  NOX  BCKGRD METER/RANGE/PPM                   .8/ 2/   1.
  DILUTION FACTOR                                 16.12
  HC   CONCENTRATION PPM                             1.
  CO   CONCENTRATION PPM                             0.
  CO2  CONCENTRATION PCT                            .78
  NOX  CONCENTRATION PPM                          33.2
  HC   MASS GRAMS                                   .11
  CO   MASS GRAMS                                   .07
  CO2  MASS GRAMS                               4646.4
  NOX  MASS GRAMS                                 20.15
  PARTICULATE MASS GRAMS                           1.95
  RUN TIME              SECONDS                 1201.
      DFC, WET (DRY)                          .938 ( .924)
      SCF, WET (DRY)                         1.000 ( .977)
      VOL (SCM)                                  323.4
      SAM BLR (SCM)                               67.99
      KM  (MEASURED)                              28.37

  TEST NUMBER,                                   1B2S71
  BAROMETER,            MM HG                     748.0
  HUMIDITY,             G/KG                       10.1
  TEMPERATURE,          DEG C                      26.1
   CARBON DIOXIDE,       G/KM                     163.8
  FUEL CONSUMPTION,     L/100KM                    6.08

  HYDROCARBONS,         G/KM                        .00
  CARBON MONOXIDE,      G/KM                        .00
  OXIDES OF NITROGEN,   G/KM                        .71
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                                   FTP    VEHICLE EMISSIONS RESULTS
                                            PROJECT 11-4874-001

TEST NO.   1B2F72   RUN   3             VEHICLE NO.1B                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      . NA FIAT CAT        DATE    4/20/81                        ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4              BAG CART NO. 1 / CVS NO.  3            DIESEL     EM-469-F
TRANSMISSION M5                         DYNO NO.       2                       ODOMETER 11484. KM( 7136. MILES)

BAROMETER 738.63 MM HG(29.08 IN HG)     DRY BULB TEMP. 27.8 DEG C(82.0 DEG F)
RELATIVE HUMIDITY  52. PCT              ABS. HUMIDITY 12.6 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.06
BAG RESULTS
  BAG NUMBER                                 1                  2                  3                  4
  DESCRIPTION                          COLD TRANSIENT      STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)        706.1 (27.8)        711.2 (28.0)       706.1 (27.8)       711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)      566.4 (22.3)        571.5 (22.5)       566.4 (22.3)       571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)     37.8 (100.0)        34.4 ( 94.0)       37.2 ( 99.0)       34.4 ( 94.0)
  BLOWER REVOLUTIONS                     13862.               23804.             13865.             23784.
  TOT FLOW STD. CU. METRES(SCF)        134.9 ( 4762.)      232.6 ( 8214.)     135.0 ( 4766.)     232.4 ( 8206.)
  HC  SAMPLE METER/RANGE/PPM           15.4/11/  15.        8.5/11/   8.      11.6/11/  12.       9.2/11/   9.
  HC  BCKGRD METER/RANGE/PPM            6.1/ 1/   6.        6.4/ 1/   6.       6.4/ 1/   6.       6.6/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM           28.7/13/  26.        6.3/13/   6.      13.3/13/  12.       6.9/13/   6.
  CO  BCKGRD METER/RANGE/PPM            1.6/13/   1.        1.4/13/   1.       4.0/13/   4.       3.2/13/   3.
  CO2 SAMPLE METER/RANGE/PCT           34.8/ 3/  .58       22.0/ 3/  .36      31.0/ 3/  .51      21.8/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT            2.9/ 3/  .04        2.6/ 3/  .04       3.2/ 3/  .05       3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM           19.8/ 2/  20.       14.2/ 2/  14.      18.6/ 2/  19.      14.5/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM             .1/ 2/   0.         .1/ 2/   0.        .5/ 2/   1.        .8/ 2/   1.
  DILUTION FACTOR                         22.86               37.52              25.78              37.87
  HC  CONCENTRATION PPM                   10.                  2.                 5.                 3.
  CO  CONCENTRATION PPM                   24.                  4.                 8.                 3.
  CO2 CONCENTRATION PCT                   .54                 .32                .47                .30
  NOX CONCENTRATION PPM                  19.7                14.1               18.1               13.7
  HC  MASS GRAMS                          .75                 .30                .43                .38
  CO  MASS GRAMS                         3.81                1.18               1.31                .90
  CO2 MASS GRAMS                       1332.4              1350.4             1152.5             1296.1
  NOX MASS GRAMS                         5.41                6.68               4.98               6.49
  PARTICULATE MASS GRAMS                  .35                 .23                .26               0.00

  HC  GRAMS/KM                            .13                 .05                .07                .06
  CO  GRAMS/KM                            .67                 .19                .23                .15
  CO2 GRAMS/KM                          234.3               220.7              201.3              209.8
  NOX GRAMS/KM                            .95                1.09                .87               1.05
  FUEL CONSUMPTION BY CB L/100KM         8.76                8.21               7.50               7.81

  RUN TIME              SECONDS          505.                867.               505.               867.
  MEASURED DISTANCE     KM               5.69                6.12               5.73               6.18
  SCF, DRY                               .978                .980               .978               .980
     DFC, WET (DRY)                           .967 ( .951)                           .969 ( .953)
     SCF, WET (DRY)                          1.000 ( .979)                          1.000 ( .979)
     VOL (SCM)                                      367.5                                  367.4
     SAM BLR (SCM)                                  78.50                                  78.41
     KM  (MEASURED)                                 11.80                                  11.90
     FUEL CONSUMPTION L/100KM                        8.47                                   7.66

COMPOSITE RESULTS                                                                          3-BAG        (4-BAG)
  TEST NUMBER         1B2F72                   CARBON DIOXIDE        G/KM                  218.2      ( 215.0)
  BAROMETER    MM HG  738.6                    FUEL CONSUMPTION      L/100KM                8.13      (   8.01)
  HUMIDITY     G/KG    12.6                    HYDROCARBONS (THC)    G/KM                    .07      (    .08)
  TEMPERATURE  DEG C   27.8                    CARBON MONOXIDE       G/KM                    .30      (    .29)
                                               OXIDES OF NITROGEN    G/KM                   1.00      (    .99)
                                               PARTICULATES          G/KM                   .044      ( 0.000)
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                                         HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B2H73   RUN   3                  VEHICLE NO.1D                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT              DATE    4/20/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                ODOMETER 11507. KM( 7150. MILES)
                                             CVS NO.   3

BAROMETER 737.87 MM HG(29.05 IN HG)          DRY BULB TEMP. 28.3 DEG C(83.0 DEG F)
RELATIVE HUMIDITY  49. PCT                   ABS. HUMIDITY 12.3 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.06
BAG RESULTS
  TEST CYCLE                                    HFET

  BLOWER DIF P MM. H2O(IN. H2O)              706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)            566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)           40.6 (105.0)
  BLOWER REVOLUTIONS                            21000.
  TOT FLOW STD. CU. METRES(SCF)              202.6 ( 7155.)
  HC  SAMPLE METER/RANGE/PPM                  9.2/11/   9.
  HC  BCKGRD METER/RANGE/PPM                  6.6/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM                  6.1/13/   6.
  CO  BCKGRD METER/RANGE/PPM                  1.8/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                 43.9/ 3/  .75
  CO2 BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 29.9/ 2/  30.
  NOX BCKGRD METER/RANGE/PPM                  .6/ 2/   1.
  DILUTION FACTOR                              17.81
  HC  CONCENTRATION PPM                          3.
  CO  CONCENTRATION PPM                          4.
  CO2 CONCENTRATION PCT                         .70
  NOX CONCENTRATION PPM                        29.3
  HC  MASS GRAMS                                .35
  CO  MASS GRAMS                                .90
  CO2 MASS GRAMS                             2613.6
  NOX MASS GRAMS                              12.00
  PARTICULATE MASS GRAMS                        .53
  RUN TIME              SECONDS                765.
       DFC, WET (DRY)                       .944 ( .929)
       SCF, WET (DRY)                      1.000 ( .977)
       VOL (SCM)                              202.6
       SAM BLR (SCM)                          43.61
       KM  (MEASURED)                         16.30

  TEST NUMBER,                               1B2H73
  BAROMETER,            MM HG                 737.9
  HUMIDITY,             G/KG                   12.3
  TEMPERATURE,          DEG C                  28.3
   CARBON DIOXIDE,       G/KM                 160.3
  FUEL CONSUMPTION,     L/100KM                5.96

  HYDROCARBONS,         G/KM                    .02
  CARBON MONOXIDE,      G/KM                    .06
  OXIDES OF NITROGEN,   G/KM                    .74
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                                       NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B2N74   RUN   3                 VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT             DATE    4/20/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                    ODOMETER 11523. KM( 7160. MILES)
                                            CVS NO.   3

BAROMETER 737.11 MM HG(29.02 IN HG)         DRY BULB TEMP. 27.8 DEG C(82.0 DEG F)
RELATIVE HUMIDITY  46. PCT                  ABS. HUMIDITY 11.0 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                  NYCC

  BLOWER DIF P MM. H2O(IN. H2O)             706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)           566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)
  BLOWER REVOLUTIONS                           16452.
  TOT FLOW STD. CU. METRES(SCF)             159.9 ( 5645.)
  HC  SAMPLE METER/RANGE/PPM                 6.9/11/   7.
  HC  BCKGRD METER/RANGE/PPM                 5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 4.0/13/   4.
  CO  BCKGRD METER/RANGE/PPM                 1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                16.3/ 3/  .26
  CO2 BCKGRD METER/RANGE/PCT                 2.6/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 8.0/ 2/   8.
  NOX BCKGRD METER/RANGE/PPM                  .3/ 2/   0.
  DILUTION FACTOR                              51.45
  HC  CONCENTRATION PPM                           2.
  CO  CONCENTRATION PPM                           3.
  CO2 CONCENTRATION PCT                          .22
  NOX CONCENTRATION PPM                          7.7
  HC  MASS GRAMS                                 .18
  CO  MASS GRAMS                                 .50
  CO2 MASS GRAMS                               645.3
  NOX MASS GRAMS                                2.38
  PARTICULATE MASS GRAMS                         .21
  RUN TIME                SECONDS               599.
      DFC, WET (DRY)                         .981 ( .966)
      SCF, WET (DRY)                        1.000 ( .983)
      VOL (SCM)                                159.9
      SAM DLR (SCM)                            34.01
      KM  (MEASURED)                            1.93

  TEST NUMBER,                                1B2N74
  BAROMETER,             MM HG                 737.1
  HUMIDITY,              G/KG                   11.0
  TEMPERATURE,           DEG C                  27.8
   CARBON DIOXIDE,        G/KM                 334.4
  FUEL CONSUMPTION,     L/100KM                12.44

  HYDROCARBONS,          G/KM                    .09
  CARBON MONOXIDE,       G/KM                    .26
  OXIDES OF NITROGEN,    G/KM                   1.23
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                                           85 KPH VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.    1B2S75   RUN   3                    VEHICLE NO.1B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                 DATE    4/20/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION M5                                 DYNO NO.      2                ODOMETER 11526. KM( 7162. MILES)
                                                CVS NO.   3

BAROMETER 736.85 MM HG(29.01 IN HG)             DRY BULB TEMP. 27.8 DEG C(82.0 DEG F)
RELATIVE HUMIDITY  46. PCT                      ABS. HUMIDITY 11.0 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                       85 K

  BLOWER DIF P MM. H2O(IN. H2O)                 706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)               566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)              41.1 (106.0)
  BLOWER REVOLUTIONS                               32943.
  TOT FLOW STD. CU. METRES(SCF)                 316.8 (11187.)
  HC  SAMPLE METER/RANGE/PPM                     6.1/11/    6.
  HC  BCKGRD METER/RANGE/PPM                     5.5/ 1/    6.
  CO  SAMPLE METER/RANGE/PPM                     4.2/13/    4.
  CO  BCKGRD METER/RANGE/PPM                     1.6/13/    1.
  CO2 SAMPLE METER/RANGE/PCT                    46.9/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT                     3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    32.9/ 2/  33.
  NOX BCKGRD METER/RANGE/PPM                      .3/ 2/   0.
  DILUTION FACTOR                                   16.57
  HC  CONCENTRATION PPM                               1.
  CO  CONCENTRATION PPM                               2.
  CO2 CONCENTRATION PCT                              .76
  NOX CONCENTRATION PPM                             32.6
  HC  MASS GRAMS                                     .16
  CO  MASS GRAMS                                     .86
  CO2 MASS GRAMS                                  4426.2
  NOX MASS GRAMS                                   19.98
  PARTICULATE MASS GRAMS                            1.28
  RUN TIME                SECONDS                  1200.
       DFC, WET (DRY)                            .940 ( .926)
       SCF, WET (DRY)                           1.000 ( .978)
       VOL (SCM)                                   316.8
       SAM BLR (SCM)                               68.13
       KM  (MEASURED)                              28.35

  TEST NUMBER,                                    1B2S75
  BARONETER,              MM HG                    736.9
  HUMIDITY,               G/KG                      11.0
  TEMPERATURE,            DEG C                     27.8
   CARBON DIOXIDE,         G/KM                    156.1
  FUEL CONSUMPTION,       L/100KM                   5.80

  HYDROCARBONS,           G/KM                       .01
  CARBON MONOXIDE,        G/KM                       .03
  OXIDES OF NITROGEN,     G/KM                       .70
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                                   FTP    VEHICLE EMISSIONS RESULTS
                                            PROJECT 11-4874-001
TEST NO.   1B2F76   RUN   4
VEHICLE MODEL        NA FIAT CAT          VEHICLE NO.1B                                   TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                DATE     4/21/81                                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                           BAG CART NO. 1 / CVS NO.  3                     DIESEL     EM-469-F
                                          DYNO NO.        2                               ODOMETER 11557. KM( 7181. MILES)

BAROMETER 739.14 MM HG(29.10 IN HG)       DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  67. PCT                ABS. HUMIDITY 13.8 GM/KG                        NOX HUMIDITY CORRECTION FACTOR  1.11
BAG RESULTS
  BAG NUMBER                                    1                 2                  3                  4
  DESCRIPTION                             COLD TRANSIENT      STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)           706.1 (27.8)      711.2 (28.0)      706.1 (27.8)      711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)         566.4 (22.3)      571.5 (22.5)      566.4 (22.3)      571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        36.7 ( 98.0)      33.9 ( 93.0)      36.7 ( 98.0)      34.4 ( 94.0)
  BLOWER REVOLUTIONS                         13873.            23799.            13866.            23800.
  TOT FLOW STD. CU. METRES(SCF)           135.2 ( 4774.)    232.9 ( 8223.)    135.1 ( 4771.)    232.6 ( 8214.)
  HC  SAMPLE METER/RANGE/PPM              11.9/11/  12.      7.3/11/   7.      9.6/11/  10.      7.0/11/   7.
  HC  BCKGRD METER/RANGE/PPM               4.9/ 1/   5.      4.9/ 1/   5.      4.9/ 1/   5.      5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM              30.6/13/  28.     13.8/13/  12.     14.4/13/  13.      8.6/13/   8.
  CO  BCKGRD METER/RANGE/PPM               8.4/13/   8.      9.5/13/   9.      6.2/13/   6.      6.4/13/   6.
  CO2 SAMPLE METER/RANGE/PCT              34.9/ 3/  .58     22.7/ 3/  .37     30.3/ 3/  .50     21.4/ 3/  .35
  CO2 BCKGRD METER/RANGE/PCT               2.9/ 3/  .04      3.2/ 3/  .05      2.7/ 3/  .04      2.8/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM              21.5/ 2/  22.     15.5/ 2/  16.     19.1/ 2/  19.     14.6/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM               1.5/ 2/   2.      1.4/ 2/   1.      1.1/ 2/   1.       .9/ 2/   1.
  DILUTION FACTOR                            22.80             36.24             26.63             38.62
  HC  CONCENTRATION PPM                       7.                3.                5.                2.
  CO  CONCENTRATION PPM                      20.                4.                7.                2.
  CO2 CONCENTRATION PCT                      .54               .32               .46               .30
  NOX CONCENTRATION PPM                     20.1              14.1              18.0              13.7
  HC  MASS GRAMS                             .56               .34               .38               .28
  CO  MASS GRAMS                            3.17              1.08              1.16               .55
  CO2 MASS GRAMS                          1340.3            1365.0            1141.0            1293.7
  NOX MASS GRAMS                            5.76              7.00              5.18              6.78
  PARTICULATE MASS GRAMS                     .28               .23               .20              0.00

  HC  GRAMS/KM                               .10               .06               .07               .05
  CO  GRAMS/KM                               .55               .17               .20               .09
  CO2 GRAMS/KM                             233.8             221.3             200.0             210.4
  NOX GRAMS/KM                              1.01              1.13               .91              1.10
  FUEL CONSUMPTION BY CB L/100KM            8.73              8.24              7.45              7.82

  RUN TIME                SECONDS          505.              867.              505.              867.
  MEASURED DISTANCE       KM               5.73              6.17              5.71              6.15
  SCF, DRY                                 .973              .975              .974              .975
        DFC, WET (DRY)                            .966 ( .945)                        .970 ( .949)
        SCF, WET (DRY)                           1.000 ( .974)                       1.000 ( .975)
        VOL (SCM)                                       368.1                               367.7
        SAM BLR (SCM)                                   70.39                               70.33
        KM  (MEASURED)                                  11.90                               11.85
        FUEL CONSUMPTION L/100KM                         8.47                                7.64
COMPOSITE RESULTS
  TEST NUMBER           1B2F76                                                             3-BAG        (4-BAG)
  BAROMETER     MM HG   739.1                   CARBON DIOXIDE          G/KM               218.1        ( 214.8)
  HUMIDITY      G/KG     13.8                   FUEL CONSUMPTION        L/100KM             8.12        (   8.00)
  TEMPERATURE   DEG C    25.0                   HYDROCARBONS (THC)      G/KM                 .07        (    .06)
                                                CARBON MONOXIDE         G/KM                 .26        (    .24)
                                                OXIDES OF NITROGEN      G/KM                1.05        (   1.04)
                                                PARTICULATES            G/KM                .039        ( 0.000)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.    1B2H77    RUN   4                    VEHICLE NO.1B                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                  DATE     4/21/81                 ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                       BAG CART NO.  1                  DIESEL      EM-469-F
TRANSMISSION M5                                  DYNO NO.      2                  ODOMETER 11581. KM( 7196. MILES)
                                                 CVS NO.   3

BAROMETER 738.63 MM HG(29.08 IN HG)              DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT                       ABS. HUMIDITY 11.2 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                          HFET

  BLOWER DIF P MM. H2O(IN. H2O)                  706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)                566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)               38.9 (102.0)
  BLOWER REVOLUTIONS                                21015.
  TOT FLOW STD. CU. METRES(SCF)                  203.7 ( 7193.)
  HC  SAMPLE METER/RANGE/PPM                      7.5/11/   8.
  HC  BCKGRD METER/RANGE/PPM                      5.6/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                      6.1/13/   6.
  CO  BCKGRD METER/RANGE/PPM                      4.2/13/   4.
  CO2 SAMPLE METER/RANGE/PCT                     43.0/ 3/  .75
  CO2 BCKGRD METER/RANGE/PCT                      3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                     29.9/ 2/  30.
  NOX BCKGRD METER/RANGE/PPM                      1.0/ 2/   1.
  DILUTION FACTOR                                    17.86
  HC  CONCENTRATION PPM                                 2.
  CO  CONCENTRATION PPM                                 2.
  CO2 CONCENTRATION PCT                               .70
  NOX CONCENTRATION PPM                              29.0
  HC  MASS GRAMS                                      .26
  CO  MASS GRAMS                                      .43
  CO2 MASS GRAMS                                   2625.9
  NOX MASS GRAMS                                    11.48
  PARTICULATE MASS GRAMS                              .65
  RUN TIME                  SECONDS                765.
       DFC, WET (DRY)                             .944 ( .928)
       SCF, WET (DRY)                            1.000 ( .976)
       VOL (SCM)                                   203.7
       SAM BLR (SCM)                               43.59
       KM  (MEASURED)                              16.19

  TEST NUMBER,                                    1B2H77
  BAROMETER,              MM HG                    738.6
  HUMIDITY,               G/KG                      11.2
  TEMPERATURE,            DEG C                     25.6
   CARBON DIOXIDE,        G/KM                     162.2
  FUEL CONSUMPTION,       L/100KM                   6.02

  HYDROCARBONS,           G/KM                      .02
  CARBON MONOXIDE,        G/KM                      .03
  OXIDES OF NITROGEN,     G/KM                      .71
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 11-4874-001

TEST NO.   1B2N78   RUN   4                    VEHICLE NO.1B                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT                DATE    4/21/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                  DIESEL     EM-469-F
TRANSMISSION M5                                DYNO NO.      2                  ODOMETER 11597. KM( 7206. MILES)
                                               CVS NO.   3

BAROMETER 738.38 MM HG(29.07 IN HG)            DRY BULB TEMP. 27.2 DEG C(81.0 DEG F)
RELATIVE HUMIDITY  48. PCT                     ABS. HUMIDITY 11.3 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                       NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)              566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)             35.6 ( 96.0)
  BLOWER REVOLUTIONS                             16446.
  TOT FLOW STD. CU. METRES(SCF)                160.4 ( 5664.)
  HC  SAMPLE METER/RANGE/PPM                    6.0/11/   6.
  HC  BCKGRD METER/RANGE/PPM                    6.2/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                    3.7/13/   3.
  CO  BCKGRD METER/RANGE/PPM                    2.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                   16.7/ 3/  .27
  CO2 BCKGRD METER/RANGE/PCT                    3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    9.7/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                    1.2/ 2/   1.
  DILUTION FACTOR                                  50.19
  HC  CONCENTRATION PPM                            -0.
  CO  CONCENTRATION PPM                             1.
  CO2 CONCENTRATION PCT                             .22
  NOX CONCENTRATION PPM                            8.5
  HC  MASS GRAMS                                   -.01
  CO  MASS GRAMS                                    .17
  CO2 MASS GRAMS                                  640.4
  NOX MASS GRAMS                                   2.66
  PARTICULATE MASS GRAMS                            .14
  RUN TIME                   SECONDS               599.
       DFC, WET (DRY)                           .980 ( .965)
       SCF, WET (DRY)                          1.000 ( .982)
       VOL (SCM)                                  160.4
       SAM BLR (SCM)                              34.17
       KM  (MEASURED)                              1.90

  TEST NUMBER,                                   1B2N78
  BAROMETER,                 MM HG                738.4
  HUMIDITY,                  G/KG                  11.3
  TEMPERATURE,               DEG C                 27.2
   CARBON DIOXIDE,            G/KM                337.7
  FUEL CONSUMPTION,          L/100KM              12.54

  HYDROCARBONS,              G/KM                  -.00
  CARBON MONOXIDE,           G/KM                   .09
  OXIDES OF NITROGEN,        G/KM                  1.40
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                                     85 KPH VEHICLE EMISSIONS RESULTS
                                          PROJECT 11-4874-001

TEST NO.   1B2S79   RUN   4                VEHICLE NO.1B                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       NA FIAT CAT            DATE     4/21/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION M5                            DYNO NO.      2                    ODOMETER 11599  KM( 7209  MILES)
                                           CVS NO.   3

BAROMETER 738.38 MM HG(29.07 IN HG)        DRY BULB TEMP. 27.2 DEG C(81.0 DEG F)
RELATIVE HUMIDITY  45. PCT                 ABS. HUMIDITY 10.5 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
   TEST CYCLE                                 85 K

   BLOWER DIF P MM. H2O(IN. H2O)           706.1 (27.8)
   BLOWER INLET P MM. H2O(IN. H2O)         566.4 (22.3)
   BLOWER INLET TEMP. DEG. C(DEG. F)        39.4 (103.0)
   BLOWER REVOLUTIONS                         32944.
   TOT FLOW STD. CU. METRES(SCF)           318.9 (11262.)
   HC  SAMPLE METER/RANGE/PPM               6.4/11/   6.
   HC  BCKGRD METER/RANGE/PPM               5.8/ 1/   6.
   CO  SAMPLE METER/RANGE/PPM               2.1/13/   2.
   CO  BCKGRD METER/RANGE/PPM               1.6/13/   1.
   CO2 SAMPLE METER/RANGE/PCT              47.4/ 3/  .82
   CO2 BCKGRD METER/RANGE/PCT               3.5/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM              33.1/ 2/  33.
   NOX BCKGRD METER/RANGE/PPM                .8/ 2/   1.
   DILUTION FACTOR                            16.38
   HC  CONCENTRATION PPM                        1.
   CO  CONCENTRATION PPM                        1.
   CO2 CONCENTRATION PCT                       .77
   NOX CONCENTRATION PPM                      32.3
   HC  MASS GRAMS                              .17
   CO  MASS GRAMS                              .19
   CO2 MASS GRAMS                           4477.9
   NOX MASS GRAMS                            19.60
   PARTICULATE MASS GRAMS                     1.59
   RUN TIME               SECONDS            1200.
        DFC, WET (DRY)                    .939 ( .925)
        SCF, WET (DRY)                   1.000 ( .978)
        VOL (SCM)                            318.9
        SAM BLR (SCM)                        68.80
        KM  (MEASURED)                       28.34

   TEST NUMBER,                             1B2S79
   BAROMETER,            MM HG               738.4
   HUMIDITY,             G/KG                 10.5
   TEMPERATURE,          DEG C                27.2
    CARBON DIOXIDE,       G/KM               158.0
   FUEL CONSUMPTION,     L/100KM              5.87

   HYDROCARBONS,         G/KM                  .01
   CARBON MONOXIDE,      G/KM                  .01
   OXIDES OF NITROGEN,   G/KM                  .69
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APPENDIX D

TEST RESULTS,
1981 OLDSMOBILE CUTLASS DIESEL
FUELS EM-329-F AND EM-469-F

SUMMARY OF REGULATED EMISSIONS FROM 1981 OLDSMOBILE CUTLASS DIESEL VEHICLE USING EM-329-F BASE FUEL

Test Code	2A1F01	2A1F05	2A1F09	2A1F13	2A1F38	2A1H02	2A1H06	2A1H10	2A1H14	2A1H39
Test Type	3-b FTP	3-b FTP	3-b FTP	3-b FTP	3-b FTP	HFET	HFET	HFET	HFET	HFET
Date (1981)	5/21	5/22	5/25	5/27	6/25	5/21	5/22	5/25	5/27	6/25
Run No.	1	2	3	4	5	1	2	3	4	5
HC, g/mi	0.19	0.19	0.14	0.19	0.23	0.13	0.14	0.13	0.13	0.14
CO, g/mi	1.01	1.06	1.05	1.08	1.05	0.69	0.68	0.69	0.71	0.71
NO_x, g/mi	1.08	1.03	1.03	1.03	1.00	0.63	0.56	0.60	0.60	0.60
Part., g/mi	0.35	0.41	0.37	--[a]	0.40	0.21	0.22	0.21	--[a]	0.20
Fuel, mi/gal	22.1	22.3	22.4	21.7	21.4	31.6	32.1	31.5	32.4	30.2

Test Code	2A1N03	2A1N07	2A1N11	2A1N15	2A1N40	2A1N42	2A1N43	2A1S04	2A1S08	2A1S12	2A1S16	2A1S41
Test Type	NYCC	NYCC	NYCC	NYCC	NYCC	NYCC	NYCC	85 kph	85 kph	85 kph	85 kph	85 kph
Date (1981)	5/21	5/22	5/25	5/27	6/25	6/25	6/25	5/21	5/22	5/25	5/27	6/25
Run No.	1	2	3	4	5	6	7	1	2	3	4	5
HC, g/mi	0.51	0.45	0.45	0.42	0.42	0.45	0.47	0.11	0.14	0.13	0.13	0.13
CO, g/mi	2.49	2.24	2.37	2.45	2.32	2.53	2.57	0.66	0.66	0.66	0.66	0.68
NO_x, g/mi	2.51	2.28	2.25	2.35	2.28	2.25	2.33	0.60	0.58	0.58	0.61	0.56
Part., g/mi	0.56	0.59	0.59	--[a]	0.54	0.57	0.58	0.17	0.16	0.15	--[a]	0.15
Fuel, mi/gal	11.1	11.6	11.7	11.3	11.4	11.0	10.8	32.0	32.4	32.4	31.9	31.9

[a] Particulate not sampled

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                               FTP    VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001

TEST NO.    2A1F01   RUN   1                  VEHICLE NC.2A                     TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDS CUTLASS              DATE     5/21/81                  ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO. 1 / CVS NO.  3       DIESEL     EM-329-F
TRANSMISSION A3                               DYNO NO.      2                   ODOMETER  4233. KM( 2630. MILES)

BAROMETER 742.19 MM HG(29.22 IN HG)           DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  53. PCT                    ABS. HUMIDITY 10.7 GM/KG
BAG RESULTS                                                                     NOX HUMIDITY CORRECTION FACTOR  1.00
  BAG NUMBER                                      1                 2                 3                  4
  DESCRIPTION                               COLD TRANSIENT      STABILIZED      HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)              701.0 (27.6)      696.0 (27.4)      698.5 (27.5)       696.0 (27.4)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)      569.0 (22.4)      571.5 (22.5)       569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)           36.7 ( 98.0)      33.9 ( 93.0)      35.6 ( 96.0)       34.4 ( 94.0)
  BLOWER REVOLUTIONS                           13862.            23806.            13862.             23813.
  TOT FLOW STD. CU. METRES(SCF)              135.6 ( 4788.)    234.1 ( 8264.)    135.9 ( 4797.)     233.9 ( 8259.)
  HC  SAMPLE METER/RANGE/PPM                 13.4/11/  13.     10.9/11/  11.     13.9/11/  14.      11.2/11/  11.
  HC  BCKGRD METER/RANGE/PPM                  5.2/ 1/   5.      5.2/ 1/   5.      5.2/ 1/   5.       4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 28.5/13/  26.     19.0/13/  17.     26.1/13/  24.      19.5/13/  18.
  CO  BCKGRD METER/RANGE/PPM                  2.8/13/   3.      2.4/13/   2.      1.9/13/   2.       1.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                 42.7/ 3/  .73     28.1/ 3/  .46     37.6/ 3/  .63      27.2/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05      3.1/ 3/  .05      3.2/ 3/  .05       3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 13.6/ 2/  14.     11.2/ 2/  11.     13.0/ 2/  13.      10.9/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                   .7/ 2/   1.       .7/ 2/   1.       .7/ 2/   1.        .8/ 2/   1.
  DILUTION FACTOR                               18.30             28.83             21.03              29.85
  HC  CONCENTRATION PPM                            8.                6.                9.                 7.
  CO  CONCENTRATION PPM                           23.               15.               22.                16.
  CO2 CONCENTRATION PCT                           .68               .42               .59                .40
  NOX CONCENTRATION PPM                          12.9              10.5              12.3               10.1
  HC  MASS GRAMS                                  .66               .79               .70                .90
  CO  MASS GRAMS                                 3.63              4.03              3.42               4.31
  CO2 MASS GRAMS                               1689.3            1783.2            1459.2             1720.2
  NOX MASS GRAMS                                 3.35              4.71              3.20               4.52
  PARTICULATE MASS GRAMS                         1.54              1.30              1.19               1.29

  HC  GRAMS/KM                                    .11               .13               .12                .15
  CO  GRAMS/KM                                    .63               .65               .59                .69
  CO2 GRAMS/KM                                  292.2             287.4             253.2              277.3
  NOX GRAMS/KM                                    .58               .76               .56                .73
  FUEL CONSUMPTION BY CB L/100KM                11.16             10.98              9.67              10.60

  RUN TIME                   SECONDS             505.              867.              505.               868.
  MEASURED DISTANCE          KM                  5.78              6.20              5.76               6.20
  SCF, DRY                                       .976              .979              .977               .979
      DFC, WET (DRY)                                   .958 ( .942)                          .961 ( .945)
      SCF, WET (DRY)                                  1.000 ( .978)                         1.000 ( .978)
      VOL (SCM)                                               369.7                                 369.7
      SAM BLR (SCM)                                           78.91                                 78.95
      KM  (MEASURED)                                          11.99                                 11.97
      FUEL CONSUMPTION L/100KM                                11.07                                 10.15

COMPOSITE RESULTS
  TEST NUMBER              2A1F01                                                          3-BAG      (4-BAG)
  BAROMETER      MM HG      742.2                 CARBON DIOXIDE          G/KM             279.0     ( 276.0)
  HUMIDITY       G/KG        10.7                 FUEL CONSUMPTION        L/100KM          10.66     ( 10.55)
  TEMPERATURE    DEG C       25.0                 HYDROCARBONS (THC)      G/KM               .12     (   .13)
                                                  CARBON MONOXIDE         G/KM               .63     (   .64)
                                                  OXIDES OF NITROGEN      G/KM               .67     (   .66)
                                                  PARTICULATES            G/KM              .220     (  .220)
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                                         HFET   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.   2A1H02   RUN   1                VEHICLE NO.2A                       TEST WEIGHT   1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS            DATE     5/21/81                    ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                 BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION A3                            DYNO NO.      2                     ODOMETER  4257. KM( 2645. MILES)
                                           CVS NO.   3

BAROMETER 741.43 MM HG(29.19 IN HG)        DRY DULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  48. PCT                 ABS. HUMIDITY 10.7 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   TEST CYCLE                                  HFET

  BLOWER DIF P MM. H2O(IN. H2O)             690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)           563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)          37.2 ( 99.0)
  BLOWER REVOLUTIONS                           21011.
  TOT FLOW STD. CU. METRES(SCF)             205.6 ( 7261.)
  HC  SAMPLE METER/RANGE/PPM                16.1/11/  16.
  HC  BCKGRD METER/RANGE/PPM                 4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                33.8/13/  31.
  CO  BCKGRD METER/RANGE/PPM                 1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                51.4/ 3/  .89
  CO2 BCKGRD METER/RANGE/PCT                 3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                16.7/ 2/  17.
  NOX BCKGRD METER/RANGE/PPM                  .6/ 2/   1.
  DILUTION FACTOR                               14.91
  HC  CONCENTRATION PPM                          12.
  CO  CONCENTRATION PPM                          29.
  CO2 CONCENTRATION PCT                          .85
  NOX CONCENTRATION PPM                         16.1
  HC  MASS GRAMS                                 1.39
  CO  MASS GRAMS                                 6.99
  CO2 MASS GRAMS                              3199.8
  NOX MASS GRAMS                                 6.34
  PARTICULATE MASS GRAMS                         2.13
  RUN TIME            SECONDS                   765.
     DFC, WET (DRY)                          .933 ( .919)
     SCF, WET (DRY)                         1.000 ( .976)
     VOL (SCM)                                  205.6
     SAM BLR (SCM)                               43.88
     KM  (MEASURED)                              16.42

  TEST NUMBER,                                 2A1H02
  BARONETER,            MM HG                   741.4
  HUMIDITY,             G/KG                     10.7
  TEMPERATURE,          DEG C                    26.7
   CARBON DIOXIDE,       G/KM                   194.8
  FUEL CONSUMPTION,     L/100KM                  7.44

  HYDROCARBONS,         G/KM                      .08
  CARBON MONOXIDE,      G/KM                      .43
  OXIDES OF NITROGEN,   G/KM                      .39
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                                       NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A1N03   RUN   1                       VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                   DATE     5/21/81                     ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                        BAG CART NO.  1                      DIESEL     EM-329-F
TRANSMISSION A3                                   DYNO NO.      2                      ODOMETER  4273. KM( 2655. MILES)
                                                  CVS NO.   3

BAROMETER 741.43 MM HG(29.19 IN HG)               DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  51. PCT                        ABS. HUMIDITY 11.4 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                          NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                  698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)                569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)               35.0 ( 95.0)
  BLOWER REVOLUTIONS                                 16447.
  TOT FLOW STD. CU. METRES(SCF)                  161.1 ( 5688.)
  HC   SAMPLE METER/RANGE/PPM                    10.6/11/  11.
  HC   BCKGRD METER/RANGE/PPM                     4.3/ 1/   4.
  CO   SAMPLE METER/RANGE/PPM                    18.3/13/  17.
  CO   BCKGRD METER/RANGE/PPM                      .8/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                    24.9/ 3/  .41
  CO2  BCKGRD METER/RANGE/PCT                     3.4/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                     9.9/ 2/  10.
  NOX  BCKGRD METER/RANGE/PPM                      .6/ 2/   1.
  DILUTION FACTOR                                    32.80
  HC   CONCENTRATION PPM                                6.
  CO   CONCENTRATION PPM                               16.
  CO2  CONCENTRATION PCT                               .36
  NOX  CONCENTRATION PPM                               9.3
  HC   MASS GRAMS                                      .59
  CO   MASS GRAMS                                     2.91
  CO2  MASS GRAMS                                   1048.1
  NOX  MASS GRAMS                                     2.94
  PARTICULATE MASS GRAMS                               .66
  RUN TIME                 SECONDS                    599.
       DFC, WET (DRY)                             .970 ( .954)
       SCF, WET (DRY)                            1.000 ( .980)
       VOL (SCM)                                     161.1
       SAM BLR (SCM)                                 34.46
       KM  (MEASURED)                                 1.88

  TEST NUMBER,                                      2A1N03
  BARMETER,                MM HG                     741.4
  HUMIDITY,                G/KG                       11.4
  TEMPERATURE,             DEG C                      26.7
   CARBON DIOXIDE,          G/KM                     556.5
  FUEL CONSUMPTION,        L/100KM                   21.28

  HYDROCARBONS,            G/KM                        .32
  CARBON MONOXIDE,         G/KM                       1.55
  OXIDES OF NITROGEN,      G/KM                       1.56
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                                         85 KPH VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.    2A1S04   RUN    1                  VEHICLE NO.2A
VEHICLE MODEL    81 OLDS CUTLASS               DATE     5/21/81                 TEST WEIGHT  1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8                     BAG CART NO.  1                  ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
TRANSMISSION A3                                DYNO NO.      2                  DIESEL     EM-329-F
                                               CVS NO.    3                     ODOMETER  4274. KM( 2656. MILES)

BAROMETER 741.43 MM HG(29.19 IN HG)            DRY BULB TEMP. 27.2 DEG C(81.0 DEG F)
RELATIVE HUMIDITY  45. PCT                     ABS. HUMIDITY 10.5 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)               696.0 (27.4)
  BLOWER INLET P MM. H2O(IN. H2O)             563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)            36.7 ( 98.0)
  BLOWER REVOLUTIONS                             32921.
  TOT FLOW STD. CU. METRES(SCF)               321.9 (11365.)
  HC   SAMPLE METER/RANGE/PPM                 16.1/11/  16.
  HC   BCKGRD METER/RANGE/PPM                  5.8/ 1/   6.
  CO   SAMPLE METER/RANGE/PPM                 35.2/13/  33.
  CO   BCKGRD METER/RANGE/PPM                   .6/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                 55.8/ 3/  .98
  CO2  BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                 18.0/ 2/  18.
  NOX  BCKGRD METER/RANGE/PPM                   .8/ 2/   1.
  DILUTION FACTOR                                13.61
  HC   CONCENTRATION PPM                          11.
  CO   CONCENTRATION PPM                          31.
  CO2  CONCENTRATION PCT                          .93
  NOX  CONCENTRATION PPM                         17.3
  HC   MASS GRAMS                                 1.99
  CO   MASS GRAMS                                11.60
  CO2  MASS GRAMS                              5498.7
  NOX  MASS GRAMS                                10.53
  PARTICULATE MASS GRAMS                          3.07
  RUN TIME                 SECONDS              1200.
     DFC, WET (DRY)                             .927 ( .913)
     SCF, WET (DRY)                            1.000 ( .976)
     VOL (SCM)                                   321.9
     SAM BLR (SCM)                               68.83
     KM   (MEASURED)                             28.53

  TEST NUMBER,                                  2A1S04
  BARometer,              MM HG                  741.4
  HUMIDITY,               G/KG                    10.5
  TEMPERATURE,            DEG C                   27.2
   CARBON DIOXIDE,         G/KM                  192.7
  FUEL CONSUMPTION,       L/100KM                 7.36

  HYDROCARBONS,           G/KM                     .07
  CARBON MONOXIDE,        G/KM                     .41
  OXIDES OF NITROGEN,     G/KM                     .37
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                                   FTP    VEHICLE EMISSIONS RESULTS
                                            PROJECT 05-4874-001

TEST NO.    2A1F05    RUN   2            VEHICLE NO.2A                          TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDS CUTLASS         DATE     5/22/81                       ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8               BAG CART NO. 1 / CVS NO.  3            DIESEL     EM-329-F
TRANSMISSION A3                          DYNO NO.      2                        ODOMETER  4308. KM( 2677. MILES)

BAROMETER 737.62 MM HG(29.04 IN HG)      DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  60. PCT               ABS. HUMIDITY 12.8 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.07
BAG RESULTS
  BAG NUMBER                                  1                  2                  3                  4
  DESCRIPTION                          COLD TRANSIENT       STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)        698.5 (27.5)        698.5 (27.5)       690.9 (27.2)        693.4 (27.3)
  BLOWER INLET P MM. H2O(IN. H2O)      569.0 (22.4)        569.0 (22.4)       561.3 (22.1)        561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)     36.1 ( 97.0)        34.4 ( 94.0)       36.7 ( 98.0)        36.1 ( 97.0)
  BLOWER REVOLUTIONS                      13865.              23835.             13866.              23820.
  TOT FLOW STD. CU. METRES(SCF)        134.4 ( 4744.)      231.6 ( 8178.)     134.4 ( 4746.)      231.1 ( 8160.)
  HC  SAMPLE METER/RANGE/PPM           13.8/11/  14.       10.1/11/  10.      14.2/11/  14.       11.2/11/  11.
  HC  BCKGRD METER/RANGE/PPM            5.1/ 1/   5.        5.1/ 1/   5.       5.1/ 1/   5.        4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM           30.5/13/  28.       20.4/13/  19.      25.3/13/  23.       17.9/13/  16.
  CO  BCKGRD METER/RANGE/PPM            2.3/13/   2.        2.0/13/   2.       1.1/13/   1.        1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT           42.5/ 3/  .72       28.8/ 3/  .47      38.0/ 3/  .64       27.5/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT            3.5/ 3/  .05        3.6/ 3/  .06       3.1/ 3/  .05        2.8/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM           12.7/ 2/  13.       10.0/ 2/  10.      12.1/ 2/  12.        9.8/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM             .7/ 2/   1.         .5/ 2/   1.        .5/ 2/   1.         .3/ 2/   0.
  DILUTION FACTOR                           18.39               28.08              20.80               29.51
  HC  CONCENTRATION PPM                      9.                  5.                 9.                  7.
  CO  CONCENTRATION PPM                     25.                 16.                21.                 15.
  CO2 CONCENTRATION PCT                      .67                 .42                .60                 .41
  NOX CONCENTRATION PPM                     12.0                 9.5               11.6                 9.5
  HC  MASS GRAMS                              .70                 .69                .72                 .88
  CO  MASS GRAMS                             3.94                4.41               3.36                4.02
  CO2 MASS GRAMS                          1657.2              1785.7             1465.6              1734.7
  NOX MASS GRAMS                             3.32                4.52               3.20                4.51
  PARTICULATE MASS GRAMS                     2.07                1.43               1.31                1.58

  HC  GRAMS/KM                                .12                 .11                .12                 .14
  CO  GRAMS/KM                                .68                 .71                .58                 .65
  CO2 GRAMS/KM                             284.2               285.9              251.4               279.0
  NOX GRAMS/KM                                .57                 .72                .55                 .72
  FUEL CONSUMPTION BY CB L/100KM            10.86               10.92               9.60               10.66

  RUN TIME              SECONDS            505.                868.               505.                868.
  MEASURED DISTANCE     KM                   5.83                6.25               5.83                6.22
  SCF, DRY                                    .974                .976               .975                .976
      DFC, WET (DRY)                              .958 ( .939)                           .961 ( .942)
      SCF, WET (DRY)                             1.000 ( .975)                          1.000 ( .976)
      VOL (SCM)                                        366.0                                  365.5
      SAM BLR (SCM)                                     77.11                                  77.22
      KM  (MEASURED)                                    12.08                                  12.05
      FUEL CONSUMPTION L/100KM                          10.89                                  10.15

COMPOSITE RESULTS                                                                              3-BAG        (4-BAG)
  TEST NUMBER          2A1F05                        CARBON DIOXIDE        G/KM                276.1       ( 274.0)
  BAROMETER     MM HG  737.6                         FUEL CONSUMPTION      L/100KM             10.55       ( 10.47)
  HUMIDITY      G/KG    12.8                         HYDROCARBONS (THC)    G/KM                  .12       (   .13)
  TEMPERATURE   DEG C   25.6                         CARBON MONOXIDE       G/KM                  .66       (   .65)
                                                     OXIDES OF NITROGEN    G/KM                  .64       (   .64)
                                                     PARTICULATES          G/KM                  .253      (   .261)
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                                          HFET   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.    2A1H06   RUN    2                VEHICLE NO.2A                   TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDS CUTLASS             DATE     5/22/81                ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                   BAG CART NO.  1                 DIESEL      EM329-F
TRANSMISSION A3                              DYNO NO.      2                 ODOMETER  4332. KM( 2692. MILES)
                                             CVS NO.    3

BAROMETER 737.62 MM HG(29.04 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                   ABS. HUMIDITY 10.5 GM/KG        NOX HUMIDITY CORRECTION FACTOR    .99
BAG RESULTS
  TEST CYCLE                                   HFET

  BLOWER DIF P MM. H2O(IN. H2O)              688.3 (27.1)
  BLOWER INLET P MM. H2O(IN. H2O)            558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)           38.9 (102.0)
  BLOWER REVOLUTIONS                            20998.
  TOT FLOW STD. CU. METRES(SCF)              203.3 ( 7179.)
  HC  SAMPLE METER/RANGE/PPM                 17.4/11/  17.
  HC  BCKGRD METER/RANGE/PPM                  4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 34.1/13/  31.
  CO  BCKGRD METER/RANGE/PPM                   .9/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 51.9/ 3/  .90
  CO2 BCKGRD METER/RANGE/PCT                  3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 15.7/ 2/  16.
  NOX BCKGRD METER/RANGE/PPM                   .4/ 2/   0.
  DILUTION FACTOR                                14.75
  HC  CONCENTRATION PPM                           13.
  CO  CONCENTRATION PPM                           30.
  CO2 CONCENTRATION PCT                           .86
  NOX CONCENTRATION PPM                          15.3
  HC  MASS GRAMS                                  1.51
  CO  MASS GRAMS                                  7.03
  CO2 MASS GRAMS                               3205.3
  NOX MASS GRAMS                                  5.92
  PARTICULATE MASS GRAMS                          2.24
  RUN TIME               SECONDS                 765.
      DFC, WET (DRY)                          .932 ( .917)
      SCF, WET (DRY)                         1.000 ( .976)
      VOL (SCM)                                203.3
      SAM BLR (SCM)                             43.18
      KM  (MEASURED)                            16.70

  TEST NUMBER,                                2A1H06
  BAROMETER,           MM HG                   737.6
  HUMIDITY,            G/KG                     10.5
  TEMPERATURE,         DEG C                    25.6
   CARBON DIOXIDE,      G/KM                   191.9
  FUEL CONSUMPTION,    L/100KM                  7.33

  HYDROCARBONS,        G/KM                      .09
  CARBON MONOXIDE,     G/KM                      .42
  OXIDES OF NITROGEN,  G/KM                      .35
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                                      NYCC   VEHICLE EMISSIONS RESULTS
                                               PROJECT 05-4874-001

TEST NO.   2A1N07   RUN   2                   VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE    5/22/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO.  1                      DIESEL    EM-329-F
TRANSMISSION A3                               DYNO NO.       2                     ODOMETER  4350. KM( 2703. MILES)
                                              CVS NO.   3

BAROMETER 737.62 MM HG(29.04 IN HG)           DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                    ABS. HUMIDITY 10.5 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
   TEST CYCLE                                    NYCC

   BLOWER DIF P MM. H2O(IN. H2O)              690.9 (27.2)
   BLOWER INLET P MM. H2O(IN. H2O)            561.3 (22.1)
   BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)
   BLOWER REVOLUTIONS                            16478.
   TOT FLOW STD. CU. METRES(SCF)              160.7 ( 5674.)
   HC  SAMPLE METER/RANGE/PPM                 10.9/11/  11.
   HC  BCKGRD METER/RANGE/PPM                  5.1/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                 17.1/13/  16.
   CO  BCKGRD METER/RANGE/PPM                   .7/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                 25.0/ 3/  .41
   CO2 BCKGRD METER/RANGE/PCT                  3.6/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM                  9.8/ 2/  10.
   NOX BCKGRD METER/RANGE/PPM                   .7/ 2/   1.
   DILUTION FACTOR                               32.67
   HC  CONCENTRATION PPM                           6.
   CO  CONCENTRATION PPM                          15.
   CO2 CONCENTRATION PCT                          .35
   NOX CONCENTRATION PPM                          9.1
   HC  MASS GRAMS                                 .56
   CO  MASS GRAMS                                2.72
   CO2 MASS GRAMS                              1041.7
   NOX MASS GRAMS                                2.79
   PARTICULATE MASS GRAMS                         .72
   RUN TIME            SECONDS                   600.
      DFC, WET (DRY)                          .969 ( .954)
      SCF, WET (DRY)                         1.000 ( .980)
      VOL (SCM)                                 160.7
      SAM BLR (SCM)                             34.27
      KM  (MEASURED)                             1.97

   TEST NUMBER,                                2A1N07
   BAROMETER,           MM HG                   737.6
   HUMIDITY,            G/KG                     10.5
   TEMPERATURE,         DEG C                    25.6
    CARBON DIOXIDE,      G/KM                   530.1
   FUEL CONSUMPTION,    L/100KM                 20.27

   HYDROCARBONS,        G/KM                      .28
   CARBON MONOXIDE,     G/KM                     1.39
   OXIDES OF NITROGEN,  G/KM                     1.42
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                                      85 KPH VEHICLE EMISSIONS RESULTS
                                           PROJECT 05-4874-001

TEST NO.   2A1S08   RUN  2                  VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS             DATE    5/22/81                    ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                  BAG CART NO.  1                    DIESEL     EM-329-F
TRANSMISSION A3                             DYNO NO.      2                    ODOMETER  4352. KM( 2704. MILES)
                                            CVS NO.   3

BAROMETER 737.87 MM HG(29.05 IN HG)         DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  50. PCT                  ABS. HUMIDITY 11.0 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                   85 K

  BLOWER DIF P MM. H2O(IN. H2O)             685.8 (27.0)
  BLOWER INLET P MM. H2O(IN. H2O)           558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          39.4 (103.0)
  BLOWER REVOLUTIONS                           32953.
  TOT FLOW STD. CU. METRES(SCF)             318.6 (11251.)
  HC  SAMPLE METER/RANGE/PPM                17.6/11/  18.
  HC  BCKGRD METER/RANGE/PPM                 4.2/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                35.8/13/  33.
  CO  BCKGRD METER/RANGE/PPM                  .7/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                55.3/ 3/  .97
  CO2 BCKGRD METER/RANGE/PCT                 3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                17.1/ 2/  17.
  NOX BCKGRD METER/RANGE/PPM                  .7/ 2/   1.
  DILUTION FACTOR                              13.74
  HC  CONCENTRATION PPM                        14.
  CO  CONCENTRATION PPM                        31.
  CO2 CONCENTRATION PCT                         .93
  NOX CONCENTRATION PPM                        16.5
  HC  MASS GRAMS                                2.51
  CO  MASS GRAMS                               11.65
  CO2 MASS GRAMS                             5411.1
  NOX MASS GRAMS                               10.12
  PARTICULATE MASS GRAMS                        2.82
  RUN TIME           SECONDS                 1200.
      DFC, WET (DRY)                         .927 ( .912)
      SCF, WET (DRY)                        1.000 ( .975)
      VOL (SCM)                               318.6
      SAM BLR (SCM)                            68.19
      KM  (MEASURED)                           28.50

  TEST NUMBER,                               2A1S08
  BAROMETER,          MM HG                   737.9
  HUMIDITY,           G/KG                     11.0
  TEMPERATURE,        DEG C                    26.1
   CARBON DIOXIDE,     G/KM                   189.9
  FUEL CONSUMPTION,   L/100KM                   7.25

  HYDROCARBONS,       G/KM                      .09
  CARBON MONOXIDE,    G/KM                      .41
  OXIDES OF NITROGEN, G/KM                      .36
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                              FTP    VEHICLE EMISSIONS RESULTS
                                       PROJECT 05-4874-001

TEST NO.   2A1F09   RUN   3                      VEHICLE NO.2A                       TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                  DATE    5/25/81                     ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                       BAG CART NO. 1 / CVS NO.  3         DIESEL    EM-329-F
TRANSMISSION A3                                  DYNO NO.       2                    ODOMETER  4397. KM( 2732. MILES)

BAROMETER 738.12 MM HG(29.06 IN HG)              DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  50. PCT                       ABS. HUMIDITY 11.0 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
   BAG NUMBER                               1                  2                  3                  4
   DESCRIPTION                       COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)     690.9 (27.2)       690.9 (27.2)       690.9 (27.2)       693.4 (27.3)
   BLOWER INLET P MM. H2O(IN. H2O)   558.8 (22.0)       561.3 (22.1)       561.3 (22.1)       563.9 (22.2)
   BLOWER INLET TEMP. DEG. C(DEG. F)  35.6 ( 96.0)       33.9 ( 93.0)       35.6 ( 96.0)       33.9 ( 93.0)
   BLOWER REVOLUTIONS                   13879.             23815.             13864.             23821.
   TOT FLOW STD. CU. METRES(SCF)     135.0 ( 4767.)     232.3 ( 8202.)     134.9 ( 4762.)     232.3 ( 8203.)
   HC   SAMPLE METER/RANGE/PPM        7.2/12/  14.       5.1/12/  10.      13.9/11/  14.      10.5/11/  11.
   HC   BCKGRD METER/RANGE/PPM        7.8/ 1/   8.       6.8/ 1/   7.       6.8/ 1/   7.       5.2/ 1/   5.
   CO   SAMPLE METER/RANGE/PPM       30.0/13/  28.      17.9/13/  16.      25.8/13/  24.      18.1/13/  16.
   CO   BCKGRD METER/RANGE/PPM        1.1/13/   1.       1.0/13/   1.        .8/13/   1.       1.0/13/   1.
   CO2 SAMPLE METER/RANGE/PCT        43.4/ 3/  .74      27.7/ 3/  .45      38.4/ 3/  .65      27.2/ 3/  .45
   CO2 BCKGRD METER/RANGE/PCT         3.3/ 3/  .05       3.2/ 3/  .05       3.9/ 3/  .06       3.7/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM        12.9/ 2/  13.      10.0/ 2/  10.      12.9/ 2/  13.      10.6/ 2/  11.
   NOX BCKGRD METER/RANGE/PPM          .2/ 2/   0.        .2/ 2/   0.        .6/ 2/   1.        .5/ 2/   1.
   DILUTION FACTOR                      17.98              29.29              20.56              29.86
   HC   CONCENTRATION PPM                 7.                 4.                 7.                 6.
   CO   CONCENTRATION PPM                26.                15.                22.                15.
   CO2 CONCENTRATION PCT                 .69                .41                .59                .39
   NOX CONCENTRATION PPM                12.7                9.8               12.3               10.1
   HC   MASS GRAMS                        .55                .49                .58                .74
   CO   MASS GRAMS                       4.06               4.06               3.49               4.11
   CO2 MASS GRAMS                      1714.3             1733.4             1459.6             1664.2
   NOX MASS GRAMS                        3.31               4.40               3.21               4.54
   PARTICULATE MASS GRAMS                1.90               1.24               1.25               1.23

   HC   GRAMS/KM                          .10                .08                .10                .12
   CO   GRAMS/KM                          .70                .65                .60                .66
   CO2 GRAMS/KM                         295.1              279.8              252.1              268.4
   NOX GRAMS/KM                           .57                .71                .55                .73
   FUEL CONSUMPTION BY CB L/100KM       11.27              10.68               9.63              10.26

   RUN TIME              SECONDS         505.               868.               505.               868.
   MEASURED DISTANCE     KM              5.81               6.20               5.79               6.20
   SCF, DRY                              .977               .980               .978               .980
        DFC, WET (DRY)                          .958 ( .942)                          .961 ( .945)
        SCF, WET (DRY)                         1.000 ( .979)                         1.000 ( .979)
        VOL (SCM)                                    367.3                                 367.2
        SAM BLR (SCM)                                 78.02                                 78.06
        KM  (MEASURED)                                12.00                                 11.99
        FUEL CONSUMPTION L/100KM                      10.97                                  9.95

COMPOSITE RESULTS                                                                          3-BAG      (4-BAG)
   TEST NUMBER         2A1F09                      CARBON DIOXIDE        G/KM             275.3     ( 272.0)
   BAROMETER    MM HG  738.1                       FUEL CONSUMPTION      L/100KM          10.52     ( 10.39)
   HUMIDITY     G/KG    11.0                       HYDROCARBONS (THC)    G/KM               .09     (    .10)
   TEMPERATURE  DEG C   26.1                       CARBON MONOXIDE       G/KM               .65     (    .65)
                                                   OXIDES OF NITROGEN    G/KM               .64     (    .64)
                                                   PARTICULATES          G/KM              .231     (   .230)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001
TEST NO.   2A1H10   RUN   3
VEHICLE MODEL   81 OLDS CUTLASS                VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8                     DATE     5/25/81                   ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
TRANSMISSION A3                                BAG CART NO.  1                    DIESEL     EM-329-F
                                               DYNO NO.      2                    ODOMETER  4421. KM( 2747. MILES)
                                               CVS NO.   3
BAROMETER 737.36 MM HG(29.03 IN HG)            DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  44. PCT                     ABS. HUMIDITY  9.6 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                      HFET

  BLOWER DIF P MM. H2O(IN. H2O)                690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)              558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.2 ( 99.0)
  BLOWER REVOLUTIONS                              21063.
  TOT FLOW STD. CU. METRES(SCF)                204.3 ( 7215.)
  HC  SAMPLE METER/RANGE/PPM                   16.9/11/  17.
  HC  BCKGRD METER/RANGE/PPM                    6.0/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                   34.5/13/  32.
  CO  BCKGRD METER/RANGE/PPM                    1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   51.9/ 3/  .90
  CO2 BCKGRD METER/RANGE/PCT                    3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   16.7/ 2/  17.
  NOX BCKGRD METER/RANGE/PPM                     .8/ 2/   1.
  DILUTION FACTOR                                  14.75
  HC  CONCENTRATION PPM                             11.
  CO  CONCENTRATION PPM                             30.
  CO2 CONCENTRATION PCT                             .86
  NOX CONCENTRATION PPM                            16.0
  HC  MASS GRAMS                                    1.33
  CO  MASS GRAMS                                    7.15
  CO2 MASS GRAMS                                 3221.2
  NOX MASS GRAMS                                    6.01
  PARTICULATE MASS GRAMS                            2.16
  RUN TIME              SECONDS                    767.
      DFC, WET (DRY)                           .932 ( .919)
      SCF, WET (DRY)                          1.000 ( .977)
      VOL (SCM)                                   204.3
      SAM BLR (SCM)                                43.60
      KM  (MEASURED)                               16.46

  TEST NUMBER,                                   2A1H10
  BARONETER,            MM HG                     737.4
  HUMIDITY,             G/KG                        9.6
  TEMPERATURE,          DEG C                      26.1
   CARBON DIOXIDE,       G/KM                     195.7
  FUEL CONSUMPTION,     L/100KM                    7.47

  HYDROCARBONS,         G/KM                        .08
  CARBON MONOXIDE,      G/KM                        .43
  OXIDES OF NITROGEN,   G/KM                        .37
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                                   NYCC   VEHICLE EMISSIONS RESULTS
                                            PROJECT 05-4874-001

TEST NO.   2A1N11   RUN   3                  VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS              DATE    5/25/81                    ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                   BAG CART NO.  1                    DIESEL    EM-329-F
TRANSMISSION A3                              DYNO NO.      2                    ODOMETER  4437. KM( 2757. MILES)
                                             CVS NO.   3

BAROMETER 737.11 MM HG(29.02 IN HG)          DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  44. PCT                   ABS. HUMIDITY  9.6 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .96
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)            558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)
  BLOWER REVOLUTIONS                           16471.
  TOT FLOW STD. CU. METRES(SCF)              160.3 ( 5662.)
  HC  SAMPLE METER/RANGE/PPM                 11.1/11/  11.
  HC  BCKGRD METER/RANGE/PPM                  5.5/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                 18.0/13/  16.
  CO  BCKGRD METER/RANGE/PPM                   .9/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 24.6/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                  3.7/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                  9.9/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                   .8/ 2/   1.
  DILUTION FACTOR                                33.22
  HC  CONCENTRATION PPM                            6.
  CO  CONCENTRATION PPM                           15.
  CO2 CONCENTRATION PCT                           .35
  NOX CONCENTRATION PPM                           9.1
  HC  MASS GRAMS                                  .54
  CO  MASS GRAMS                                 2.84
  CO2 MASS GRAMS                               1014.6
  NOX MASS GRAMS                                 2.70
  PARTICULATE MASS GRAMS                          .71
  RUN TIME               SECONDS                 600.
      DFC, WET (DRY)                        .970 ( .956)
      SCF, WET (DRY)                       1.000 ( .982)
      VOL (SCM)                                 160.3
      SAM BLR (SCM)                             34.25
      KM  (MEASURED)                             1.93

  TEST NUMBER,                                 2A1N11
  BAROMETER,            MM HG                   737.1
  HUMIDITY,             G/KG                      9.6
  TEMPERATURE,          DEG C                    26.1
   CARBON DIOXIDE,       G/KM                   525.7
  FUEL CONSUMPTION,     L/100KM                 20.10

  HYDROCARBONS,         G/KM                      .28
  CARBON MONOXIDE,      G/KM                     1.47
  OXIDES OF NITROGEN,   G/KM                     1.40
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                                     85 KPH VEHICLE EMISSIONS RESULTS
                                          PROJECT 05-4874-001

  TEST NO.   2A1S12   RUN   3                 VEHICLE NO.2A                    TEST WEIGHT  1814. KG( 4000. LBS)
  VEHICLE MODEL   81 OLDS CUTLASS             DATE    5/25/81                  ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
  ENGINE 5.7 L(350. CID) V-8                  BAG CART NO.  1                  DIESEL    EM-329-F
  TRANSMISSION A3                             DYNO NO.      2                  ODOMETER  4439. KM( 2758. MILES)
                                              CVS NO.   3

  BAROMETER 736.85 MM HG(29.01 IN HG)         DRY BULD TEMP. 26.1 DEG C(79.0 DEG F)
  RELATIVE HUMIDITY  47. PCT                  ABS. HUMIDITY 10.3 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .99
0 BAG RESULTS
    TEST CYCLE                                   85 K

    BLOWER DIF P MM. H2O(IN. H2O)             690.9 (27.2)
    BLOWER INLET P MM. H2O(IN. H2O)           558.8 (22.0)
    BLOWER INLET TEMP. DEG. C(DEG. F)          40.6 (105.0)
    BLOWER REVOLUTIONS                           32965.
    TOT FLOW STD. CU. METRES(SCF)             317.4 (11206.)
    HC  SAMPLE METER/RANGE/PPM                16.9/11/  17.
    HC  BCKGRD METER/RANGE/PPM                 5.5/ 1/   6.
    CO  SAMPLE METER/RANGE/PPM                35.6/13/  33.
    CO  BCKGRD METER/RANGE/PPM                  .6/13/   1.
    CO2 SAMPLE METER/RANGE/PCT                56.1/ 3/  .99
    CO2 BCKGRD METER/RANGE/PCT                 3.8/ 3/  .06
    NOX SAMPLE METER/RANGE/PPM                17.5/ 2/  18.
    NOX BCKGRD METER/RANGE/PPM                  .4/ 2/   0.
    DILUTION FACTOR                                13.53
    HC  CONCENTRATION PPM                          12.
    CO  CONCENTRATION PPM                          31.
    CO2 CONCENTRATION PCT                          .93
    NOX CONCENTRATION PPM                          17.1
    HC  MASS GRAMS                                 2.15
    CO  MASS GRAMS                                 11.57
    CO2 MASS GRAMS                               5414.6
    NOX MASS GRAMS                                 10.26
    PARTICULATE MASS GRAMS                          4.40
    RUN TIME              SECONDS               1200.
        DFC, WET (DRY)                        .926 ( .912)
        SCF, WET (DRY)                       1.000 ( .976)
        VOL (SCM)                               317.4
        SAM BLR (SCM)                           68.38
        KM  (MEASURED)                          28.49

    TEST NUMBER,                               2A1S12
    BARONETER,            MM HG                736.9
    HUMIDITY,             G/KG                  10.3
    TEMPERATURE,          DEG C                 26.1
     CARBON DIOXIDE,       G/KM                 190.1
    FUEL CONSUMPTION,     L/100KM                7.26

    HYDROCARBONS,         G/KM                   .08
    CARBON MONOXIDE,      G/KM                   .41
    OXIDES OF NITROGEN,   G/KM                   .36
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                                        FTP    VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A1F13   RUN   4                   VEHICLE NO.2A                           TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE     5/27/81                        ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO. 1 / CVS NO.  3             DIESEL     EM-329-F
TRANSMISSION A3                               DYNO NO.      2                         ODOMETER  4480. KM( 2784. MILES)

BAROMETER 737.87 MM HG(29.05 IN HG)           DRY BULB TEMP. 28.3 DEG C(83.0 DEG F)
RELATIVE HUMIDITY  43. PCT                    ABS. HUMIDITY 10.8 GM/KG                NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  BAG NUMBER                                       1                 2                 3                 4
  DESCRIPTION                                COLD TRANSIENT      STABILIZED      HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)              696.0 (27.4)      690.9 (27.2)      698.5 (27.5)      690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)            563.9 (22.2)      563.9 (22.2)      569.0 (22.4)      563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)           36.1 ( 97.0)      35.6 ( 96.0)      36.1 ( 97.0)      35.6 ( 96.0)
  BLOWER REVOLUTIONS                            13856.            23818.            13863.            23812.
  TOT FLOW STD. CU. METRES(SCF)              134.2 ( 4737.)    230.8 ( 8150.)    134.2 ( 4737.)    230.8 ( 8149.)
  HC  SAMPLE METER/RANGE/PPM                 20.7/11/  21.     16.8/11/  17.     20.1/11/  20.     17.1/11/  17.
  HC  BCKGRD METER/RANGE/PPM                 11.9/ 1/  12.     11.5/ 1/  12.     11.5/ 1/  12.     11.0/ 1/  11.
  CO  SAMPLE METER/RANGE/PPM                 30.7/13/  28.     19.9/13/  18.     27.0/13/  25.     19.6/13/  18.
  CO  BCKGRD METER/RANGE/PPM                  1.8/13/   2.      1.8/13/   2.      1.6/13/   1.      1.6/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 43.7/ 3/  .75     29.0/ 3/  .48     37.9/ 3/  .64     27.7/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05      2.8/ 3/  .04      3.1/ 3/  .05      3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 13.7/ 2/  14.     10.9/ 2/  11.     12.3/ 2/  12.     10.5/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                   .6/ 2/   1.       .6/ 2/   1.       .6/ 2/   1.       .5/ 2/   1.
  DILUTION FACTOR                               17.82             27.84             20.83             29.24
  HC  CONCENTRATION PPM                          9.                6.                9.                6.
  CO  CONCENTRATION PPM                         26.               16.               23.               16.
  CO2 CONCENTRATION PCT                          .70               .44               .59               .40
  NOX CONCENTRATION PPM                         13.1              10.3              11.7              10.0
  HC  MASS GRAMS                                 .73               .76               .71               .86
  CO  MASS GRAMS                                4.05              4.34              3.55              4.31
  CO2 MASS GRAMS                              1721.2            1845.1            1458.3            1703.1
  NOX MASS GRAMS                                3.38              4.57              3.02              4.43

  HC  GRAMS/KM                                   .13               .12               .12               .14
  CO  GRAMS/KM                                   .69               .69               .62               .70
  CO2 GRAMS/KM                                 294.4             295.0             253.4             276.4
  NOX GRAMS/KM                                   .58               .73               .52               .72
  FUEL CONSUMPTION BY CB L/100KM               11.25             11.27              9.68             10.56

  RUN TIME      .         SECONDS            505.              868.              505.              868.
  MEASURED DISTANCE       KM                 5.85              6.25              5.76              6.16
  SCF, DRY                                   .979              .982              .980              .982
       DFC, WET (DRY)                                .957 ( .943)                        .961 ( .947)
       SCF, WET (DRY)                               1.000 ( .981)                       1.000 ( .981)
       VOL (SCM)                                           365.0                               364.9
       SAM BLR (SCM)                                       77.81                               77.80
       KM  (MEASURED)                                      12.10                               11.92
       FUEL CONSUMPTION L/100KM                            11.26                               10.14
COMPOSITE RESULTS
   TEST NUMBER           2A1F13                                                                3-BAG        (4-BAG)
   BAROMETER     MM HG    737.9                          CARBON DIOXIDE          G/KM         283.5        ( 277.9)
   HUMIDITY      G/KG      10.8                          FUEL CONSUMPTION        L/100KM      10.83        ( 10.62)
   TEMPERATURE   DEG C     28.3                          HYDROCARBONS (THC)      G/KM           .12        (   .13)
                                                         CARBON MONOXIDE         G/KM           .67        (   .67)
                                                         OXIDES OF NITROGEN      G/KM           .64        (   .64)
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                                   HFET   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.    2A1H14    RUN    4             VEHICLE NO.2A                       TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDA CUTLASS           DATE     5/27/81                    ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                 BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION A3                            DYNO NO.       2                    ODOMETER  4505. KM( 2799. MILES)
                                           CVS NO.    3

BAROMETER 736.85 MM HG(29.01 IN HG)        DRY BULB TEMP. 28.9 DEG C(84.0 DEG F)
RELATIVE HUMIDITY  44. PCT                 ABS. HUMIDITY 11.3 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                  HFET

  BLOWER DIF P MM. H2O(IN. H2O)            690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)          563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)         37.8 (100.0)
  BLOWER REVOLUTIONS                          20999.
  TOT FLOW STD. CU. METRES(SCF)            202.6 ( 7153.)
  HC   SAMPLE METER/RANGE/PPM              22.2/11/  22.
  HC   BCKGRD METER/RANGE/PPM              11.3/ 1/  11.
  CO   SAMPLE METER/RANGE/PPM              35.0/13/  32.
  CO   BCKGRD METER/RANGE/PPM               1.4/13/   1.
  CO2  SAMPLE METER/RANGE/PCT              50.2/ 3/  .87
  CO2  BCKGRD METER/RANGE/PCT               2.7/ 3/  .04
  NOX  SAMPLE METER/RANGE/PPM              15.9/ 2/  16.
  NOX  BCKGRD METER/RANGE/PPM                .6/ 2/   1.
  DILUTION FACTOR                              15.29
  HC   CONCENTRATION PPM                        12.
  CO   CONCENTRATION PPM                        30.
  CO2  CONCENTRATION PCT                        .83
  NOX  CONCENTRATION PPM                       15.3
  HC   MASS GRAMS                               1.36
  CO   MASS GRAMS                               7.12
  CO2  MASS GRAMS                            3087.2
  NOX  MASS GRAMS                               6.06
  RUN TIME                  SECONDS            765.
       DFC, WET (DRY)                      .935 ( .921)
       SCF, WET (DRY)                     1.000 ( .978)
       VOL (SCM)                               202.6
       SAM BLR (SCM)                           43.25
       KM  (MEASURED)                          16.24

  TEST NUMBER,                               2A1H14
  BARONETER,              MM HG               736.9
  HUMIDITY,               G/KG                 11.3
  TEMPERATURE,            DEG C                28.9
   CARBON DIOXIDE,         G/KM               190.1
  FUEL CONSUMPTION,       L/100KM              7.26

  HYDROCARBONS,           G/KM                  .08
  CARBON MONOXIDE,        G/KM                  .44
  OXIDES OF NITROGEN,     G/KM                  .37
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A1N15   RUN   4                     VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                 DATE    5/27/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                      BAG CART NO.  1                      DIESEL    EM-329-F
TRANSMISSION A3                                 DYNO NO.      2                      ODOMETER  4521. KM( 2809. MILES)
                                                CVS NO.   3

BAROMETER 736.85 MM HG(29.01 IN HG)             DRY BULB TEMP. 28.3 DEG C(83.0 DEG F)
RELATIVE HUMIDITY  40. PCT                      ABS. HUMIDITY 10.1 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  TEST CYCLE                                        NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                 696.0 (27.4)
  BLOWER INLET P MM. H2O(IN. H2O)               563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)              36.1 ( 97.0)
  BLOWER REVOLUTIONS                               16472.
  TOT FLOW STD. CU. METRES(SCF)                 159.2 ( 5621.)
  HC  SAMPLE METER/RANGE/PPM                    15.9/11/  16.
  HC  BCKGRD METER/RANGE/PPM                    10.9/ 1/  11.
  CO  SAMPLE METER/RANGE/PPM                    18.6/13/  17.
  CO  BCKGRD METER/RANGE/PPM                     1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    24.8/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                     3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    10.0/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                      .6/ 2/   1.
  DILUTION FACTOR                                   32.89
  HC  CONCENTRATION PPM                               5.
  CO  CONCENTRATION PPM                              16.
  CO2 CONCENTRATION PCT                              .36
  NOX CONCENTRATION PPM                              9.4
  HC  MASS GRAMS                                     .49
  CO  MASS GRAMS                                    2.91
  CO2 MASS GRAMS                                  1048.1
  NOX MASS GRAMS                                    2.81
  RUN TIME               SECONDS                    600.
      DFC, WET (DRY)                             .970 ( .957)
      SCF, WET (DRY)                            1.000 ( .983)
      VOL (SCM)                                    159.2
      SAM BLR (SCM)                                33.93
      KM  (MEASURED)                                1.92

  TEST NUMBER,                                     2A1N15
  BAROMETER,            MM HG                      736.9
  HUMIDITY,             G/KG                        10.1
  TEMPERATURE,          DEG C                       28.3
   CARBON DIOXIDE,       G/KM                      546.5
  FUEL CONSUMPTION,     L/100KM                    20.90

  HYDROCARBONS,         G/KM                         .26
  CARBON MONOXIDE,      G/KM                        1.52
  OXIDES OF NITROGEN,   G/KM                        1.46
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   2A1S16   RUN   4                 VEHICLE NO.2A                       TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS             DATE     5/27/81                    ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                  BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION A3                             DYNO NO.      2                     ODOMETER  4522. KM( 2810. MILES)
                                            CVS NO.   3

BAROMETER 736.60 MM HG(29.00 IN HG)         DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  57. PCT                  ABS. HUMIDITY 12.5 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.06
BAG RESULTS
   TEST CYCLE                                 85 K

  BLOWER DIF P MM. H2O(IN. H2O)             685.8 (27.0)
  BLOWER INLET P MM. H2O(IN. H2O)           558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          38.9 (102.0)
  BLOWER REVOLUTIONS                            32940.
  TOT FLOW STD. CU. METRES(SCF)             316.7 (11183.)
  HC  SAMPLE METER/RANGE/PPM                22.1/11/  22.
  HC  BCKGRD METER/RANGE/PPM                10.9/ 1/  11.
  CO  SAMPLE METER/RANGE/PPM                36.7/13/  34.
  CO  BCKGRD METER/RANGE/PPM                 1.3/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                56.2/ 3/  .99
  CO2 BCKGRD METER/RANGE/PCT                 2.8/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                17.6/ 2/  18.
  NOX BCKGRD METER/RANGE/PPM                 1.0/ 2/   1.
  DILUTION FACTOR                               13.49
  HC  CONCENTRATION PPM                          12.
  CO  CONCENTRATION PPM                          32.
  CO2 CONCENTRATION PCT                          .95
  NOX CONCENTRATION PPM                         16.7
  HC  MASS GRAMS                                 2.20
  CO  MASS GRAMS                                11.67
  CO2 MASS GRAMS                              5497.9
  NOX MASS GRAMS                                10.75
  RUN TIME                  SECONDS            1200.
       DFC, WET (DRY)                       .926 ( .909)
       SCF, WET (DRY)                      1.000 ( .972)
       VOL (SCM)                               316.7
       SAM BLR (SCM)                            67.60
       KM  (MEASURED)                           28.49

  TEST NUMBER,                                2A1S16
  BARONETER,              MM HG                736.6
  HUMIDITY,               G/KG                  12.5
  TEMPERATURE,            DEG C                 26.1
   CARBON DIOXIDE,         G/KM                193.0
  FUEL CONSUMPTION,      L/100KM                7.37

  HYDROCARBONS,           G/KM                  .08
  CARBON MONOXIDE,        G/KM                  .41
  OXIDES OF NITROGEN,     G/KM                  .38
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                       FTP    VEHICLE EMISSIONS RESULTS
                               PROJECT 05-4874-001

TEST NO.   2A1F38   RUN   5            VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS        DATE    6/25/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8             BAG CART NO. 1 / CVS NO.  3          DIESEL     EM-329-F
TRANSMISSION A3                        DYNO NO.      2                      ODOMETER  4978. KM( 3093. MILES)

BAROMETER 744.47 MM HG(29.31 IN HG)    DRY BULB TEMP. 22.8 DEG C(73.0 DEG F)
RELATIVE HUMIDITY  65. PCT             ABS. HUMIDITY 11.6 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  BAG NUMBER                                  1                 2                 3                 4
  DESCRIPTION                          COLD TRANSIENT       STABILIZED      HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)        698.5 (27.5)      706.1 (27.8)      706.1 (27.8)      706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)      563.9 (22.2)      571.5 (22.5)      566.4 (22.3)      571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)     35.8 ( 96.5)      32.2 ( 90.0)      35.0 ( 95.0)      31.9 ( 89.5)
  BLOWER REVOLUTIONS                     13853.            23826.            13865.            23820.
  TOT FLOW STD. CU. METRES(SCF)        135.2 ( 4775.)    234.1 ( 8265.)    135.5 ( 4784.)    234.2 ( 8269.)
  HC  SAMPLE METER/RANGE/PPM           17.0/11/  17.     12.5/11/  12.     14.3/11/  14.     11.0/11/  11.
  HC  BCKGRD METER/RANGE/PPM            7.1/ 1/   7.      5.7/ 1/   6.      5.7/ 1/   6.      5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM           32.2/13/  30.     20.7/13/  19.     26.1/13/  24.     19.5/13/  18.
  CO  BCKGRD METER/RANGE/PPM            4.3/13/   4.      3.7/13/   3.      2.1/13/   2.      2.1/13/   2.
  CO2 SAMPLE METER/RANGE/PCT           44.1/ 3/  .75     28.8/ 3/  .47     38.1/ 3/  .64     28.3/ 3/  .47
  CO2 BCKGRD METER/RANGE/PCT            3.4/ 3/  .05      3.1/ 3/  .05      3.0/ 3/  .05      3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM           12.5/ 2/  13.      9.8/ 2/  10.     11.7/ 2/  12.      9.6/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM             .4/ 2/   0.       .5/ 2/   1.       .3/ 2/   0.       .4/ 2/   0.
  DILUTION FACTOR                         17.65             28.07             20.73             28.61
  HC  CONCENTRATION PPM                   10.                7.                9.                6.
  CO  CONCENTRATION PPM                   25.               15.               21.               15.
  CO2 CONCENTRATION PCT                   .71               .43               .60               .42
  NOX CONCENTRATION PPM                   12.1               9.3              11.4               9.2
  HC  MASS GRAMS                           .80               .94               .69               .83
  CO  MASS GRAMS                          3.94              4.12              3.36              4.20
  CO2 MASS GRAMS                        1746.5            1836.6            1485.6            1805.7
  NOX MASS GRAMS                          3.23              4.30              3.05              4.25
  PARTICULATE MASS GRAMS                  2.21              1.30              1.28              1.22

  HC  GRAMS/KM                             .14               .15               .12               .13
  CO  GRAMS/KM                             .68               .67               .59               .68
  CO2 GRAMS/KM                           303.0             296.9             258.8             293.2
  NOX GRAMS/KM                             .56               .69               .53               .69
  FUEL CONSUMPTION BY CB L/100KM         11.58             11.34              9.89             11.20

  RUN TIME               SECONDS          504.              868.              505.              868.
  MEASURED DISTANCE      KM               5.76              6.19              5.74              6.16
  SCF, DRY                                .972              .975              .973              .975
     DFC, WET (DRY)                             .957 ( .936)                        .960 ( .940)
     SCF, WET (DRY)                            1.000 ( .974)                       1.000 ( .974)
     VOL (SCM)                                       369.3                               369.7
     SAM BLR (SCM)                                   77.85                               77.88
     KM  (MEASURED)                                  11.95                               11.90
     FUEL CONSUMPTION L/100KM                        11.45                               10.57

COMPOSITE RESULTS                                                                        3-BAG      (4-BAG)
  TEST NUMBER            2A1F38                    CARBON DIOXIDE          G/KM          287.7     ( 286.6)
  BAROMETER     MM HG    744.5                     FUEL CONSUMPTION        L/100KM       10.99     ( 10.95)
  HUMIDITY      G/KG      11.6                     HYDROCARBONS (THC)      G/KM            .14     (   .14)
  TEMPERATURE   DEG C     22.8                     CARBON MONOXIDE         G/KM            .65     (   .65)
                                                   OXIDES OF NITROGEN      G/KM            .62     (   .62)
                                                   PARTICULATES            G/KM           .250     (  .246)
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                                  HFET   VEHICLE EMISSIONS RESULTS
                                            PROJECT 05-4874-001

TEST NO.   2A1H39   RUN   5                    VEHICLE NO.2A                          TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                DATE     6/25/81                       ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                     BAG CART NO.  1                        DIESEL     EM-329-F
TRANSMISSION A3                                DYNO NO.      2                        ODOMETER  5003. KM( 3109. MILES)
                                               CVS NO.   3

BAROMETER 744.73 MM HG(29.32 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  56. PCT                     ABS. HUMIDITY 11.4 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                     HFET

  BLOWER DIF P MM. H2O(IN. H2O)                698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)              566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)             36.4 ( 97.5)
  BLOWER REVOLUTIONS                              21023.
  TOT FLOW STD. CU. METRES(SCF)                205.4 ( 7254.)
  HC  SAMPLE METER/RANGE/PPM                   16.4/11/  16.
  HC  BCKGRD METER/RANGE/PPM                    5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                   35.2/13/  33.
  CO  BCKGRD METER/RANGE/PPM                    1.5/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   53.2/ 3/  .93
  CO2 BCKGRD METER/RANGE/PCT                    3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   15.3/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                     .1/ 2/   0.
  DILUTION FACTOR                                 14.35
  HC  CONCENTRATION PPM                             12.
  CO  CONCENTRATION PPM                             30.
  CO2 CONCENTRATION PCT                             .88
  NOX CONCENTRATION PPM                            15.2
  HC  MASS GRAMS                                   1.39
  CO  MASS GRAMS                                   7.21
  CO2 MASS GRAMS                                 3328.8
  NOX MASS GRAMS                                   6.10
  PARTICULATE MASS GRAMS                           2.06
  RUN TIME             SECONDS                     765.
     DFC, WET (DRY)                            .930 ( .913)
     SCF, WET (DRY)                           1.000 ( .973)
     VOL (SCM)                                    205.4
     SAM BLR (SCM)                                43.83
     KM  (MEASURED)                               16.35

  TEST NUMBER,                                   2A1H39
  BAROMETER,           MM HG                      744.7
  HUMIDITY,            G/KG                        11.4
  TEMPERATURE,         DEG C                       25.0
   CARBON DIOXIDE,      G/KM                      203.6
  FUEL CONSUMPTION,    L/100KM                     7.78

  HYDROCARBONS,        G/KM                         .09
  CARBON MONOXIDE,     G/KM                         .44
  OXIDES OF NITROGEN,  G/KM                         .37
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001
TEST NO.   2A1N40    RUN   5
VEHICLE MODEL    81 OLDW CUTLASS                  VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8                        DATE     6/25/81                   ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
TRANSMISSION A3                                   BAG CART NO.  1                    DIESEL     EM-329-F
                                                  DYNO NO.      2                    ODOMETER  5020. KM( 3119. MILES)
                                                  CVS NO.    3

BAROMETER 744.73 MM HG(29.32 IN HG)               DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  59. PCT                        ABS. HUMIDITY 11.1 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                         NYCC

  BLOWER DIF P MM. H20(IN. H20)                   706.1 (27.8)
  BLOWER INLET P MM. H20(IN. H20)                 571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)                33.6 ( 92.5)
  BLOWER REVOLUTIONS                                 16456.
  TOT FLOW STD. CU. METRES(SCF)                   161.3 ( 5696.)
  HC  SAMPLE METER/RANGE/PPM                      10.2/11/  10.
  HC  BCKGRD METER/RANGE/PPM                       5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                      18.0/13/  16.
  CO  BCKGRD METER/RANGE/PPM                       1.6/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                      24.2/ 3/  .39
  CO2 BCKGRD METER/RANGE/PCT                       3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                       8.7/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                        .1/ 2/   0.
  DILUTION FACTOR                                     33.81
  HC  CONCENTRATION PPM                                 5.
  CO  CONCENTRATION PPM                                15.
  CO2 CONCENTRATION PCT                                .35
  NOX CONCENTRATION PPM                                8.6
  HC  MASS GRAMS                                        .50
  CO  MASS GRAMS                                       2.73
  CO2 MASS GRAMS                                     1026.7
  NOX MASS GRAMS                                       2.69
  PARTICULATE MASS GRAMS                                .64
  RUN TIME              SECONDS                        600.
      DFC, WET (DRY)                              .970 ( .952)
      SCF, WET (DRY)                             1.000 ( .977)
      VOL (SCM)                                       161.3
      SAM BLR (SCM)                                   34.13
      KM  (MEASURED)                                   1.89

  TEST NUMBER,                                       2A1N40
  BAROMETER,            MM HG                         744.7
  HUMIDITY,             G/KG                           11.1
  TEMPERATURE,          DEG C                          23.9
   CARBON DIOXIDE,       G/KM                         542.0
  FUEL CONSUMPTION,     L/100KM                       20.72

  HYDROCARBONS,         G/KM                            .26
  CARBON MONOXIDE,      G/KM                           1.44
  OXIDES OF NITROGEN,   G/KM                           1.42
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                              85 KPH VEHICLE EMISSIONS RESULTS
                                   PROJECT 05-4074-001
TEST NO.   2A1S41    RUN   5           VEHICLE NO.2A
VEHICLE MODEL   81 OLDS CUTLASS        DATE    6/25/81               TEST WEIGHT  1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8             BAG CART NO.  1               ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
TRANSMISSION A3                        DYNO NO.      2               DIESEL     EM-329-F
                                       CVS NO.   3                   ODOMETER   5022. KM( 3121. MILES)

BAROMETER 744.73 MM HG(29.32 IN HG)    DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT             ABS. HUMIDITY 11.1 GM/KG      NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                              85 K

  BLOWER DIF P MM. H2O(IN. H2O)        698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)      566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)     37.5 ( 99.5)
  BLOWER REVOLUTIONS                      32930.
  TOT FLOW STD. CU. METRES(SCF)        321.2 (11343.)
  HC  SAMPLE METER/RANGE/PPM           16.4/11/  16.
  HC  BCKGRD METER/RANGE/PPM            4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM           36.7/13/  34.
  CO  BCKGRD METER/RANGE/PPM            1.4/13/   1.
  CO2 SAMPLE METER/RANGE/PCT           55.6/ 3/  .98
  CO2 BCKGRD METER/RANGE/PCT            3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM           16.4/ 2/  16.
  NOX BCKGRD METER/RANGE/PPM             .3/ 2/   0.
  DILUTION FACTOR                          13.66
  HC  CONCENTRATION PPM                     12.
  CO  CONCENTRATION PPM                     32.
  CO2 CONCENTRATION PCT                      .93
  NOX CONCENTRATION PPM                    16.1
  HC  MASS GRAMS                             2.26
  CO  MASS GRAMS                            11.83
  CO2 MASS GRAMS                          5481.8
  NOX MASS GRAMS                            10.04
  PARTICULATE MASS GRAMS                     2.68
  RUN TIME              SECONDS           1200.
      DFC, WET (DRY)                    .927 ( .911)
      SCF, WET (DRY)                   1.000 ( .974)
      VOL (SCM)                            321.2
      SAM BLR (SCM)                         68.57
      KM  (MEASURED)                        28.37

  TEST NUMBER,                            2A1S41
  BARONETER,            MM HG              744.7
  HUMIDITY,             G/KG                11.1
  TEMPERATURE,          DEG C               25.6
   CARBON DIOXIDE,       G/KM              193.2
  FUEL CONSUMPTION,     L/100KM             7.38

  HYDROCARBONS,         G/KM                 .08
  CARBON MONOXIDE,      G/KM                 .42
  OXIDES OF NITROGEN,   G/KM                 .35
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                                            NYCC   VEHICLE EMISSIONS RESULTS
                                                     PROJECT 05-4874-001

TEST NO.   2A1N42   RUN  6                   VEHICLE NO.2A                    TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS              DATE     6/25/81                 ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                   BAG CART NO.  1                  DIESEL     EM-329-F
TRANSMISSION A3                              DYNO NO.      2                  ODOMETER  5050. KM( 3138. MILES)
                                             CVS NO.   3

BAROMETER 744.47 MM HG(29.31 IN HG)          DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  55. PCT                   ABS. HUMIDITY 10.4 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           33.9 ( 93.0)
  BLOWER REVOLUTIONS                            16471.
  TOT FLOW STD. CU. METRES(SCF)              161.5 ( 5703.)
  HC  SAMPLE METER/RANGE/PPM                 10.4/11/  10.
  HC  BCKGRD METER/RANGE/PPM                  5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 18.9/13/  17.
  CO  BCKGRD METER/RANGE/PPM                  1.3/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 24.7/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  8.9/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                   .3/ 2/   0.
  DILUTION FACTOR                                33.08
  HC  CONCENTRATION PPM                            6.
  CO  CONCENTRATION PPM                           16.
  CO2 CONCENTRATION PCT                           .35
  NOX CONCENTRATION PPM                           8.6
  HC  MASS GRAMS                                  .52
  CO  MASS GRAMS                                 2.94
  CO2 MASS GRAMS                               1044.9
  NOX MASS GRAMS                                 2.63
  PARTICULATE MASS GRAMS                          .67
  RUN TIME              SECONDS                  600.
       DFC, WET (DRY)                        .970 ( .953)
       SCF, WET (DRY)                       1.000 ( .979)
       VOL (SCM)                                161.5
       SAM BLR (SCM)                            34.36
       KM  (MEASURED)                            1.88

  TEST NUMBER,                                 2A1N42
  BAROMETER,             MM HG                  744.5
  HUMIDITY,              G/KG                    10.4
  TEMPERATURE,           DEG C                   23.9
   CARBON DIOXIDE,        G/KM                  557.3
  FUEL CONSUMPTION,      L/100KM                21.31

  HYDROCARBONS,          G/KM                     .28
  CARBON MONOXIDE,       G/KM                    1.57
  OXIDES OF NITROGEN,    G/KM                    1.40
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A1N43   RUN  7                     VEHICLE NO.2A                  TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                DATE     6/25/81               ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                     BAG CART NO.  1                DIESEL     EM-329-F
TRANSMISSION A3                                DYNO NO.      2                ODOMETER  5053. KM( 3140. MILES)
                                               CVS NO.   3

BAROMETER 744.22 MM HG(29.30 IN HG)            DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  55. PCT                     ABS. HUMIDITY 10.9 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)               706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)             571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)            33.3 ( 92.0)
  BLOWER REVOLUTIONS                            16441.
  TOT FLOW STD. CU. METRES(SCF)               161.3 ( 5697.)
  HC  SAMPLE METER/RANGE/PPM                  10.2/11/  10.
  HC  BCKGRD METER/RANGE/PPM                   4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                  18.9/13/  17.
  CO  BCKGRD METER/RANGE/PPM                   1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                  24.7/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                   3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   8.9/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                    .3/ 2/   0.
  DILUTION FACTOR                                33.08
  HC  CONCENTRATION PPM                            6.
  CO  CONCENTRATION PPM                           16.
  CO2 CONCENTRATION PCT                           .35
  NOX CONCENTRATION PPM                           8.6
  HC  MASS GRAMS                                  .54
  CO  MASS GRAMS                                 2.95
  CO2 MASS GRAMS                               1048.2
  NOX MASS GRAMS                                 2.67
  PARTICULATE MASS GRAMS                          .66
  RUN TIME          SECONDS                      599.
      DFC, WET (DRY)                          .970 ( .952)
      SCF, WET (DRY)                         1.000 ( .978)
      VOL (SCM)                               161.3
      SAM BLR (SCM)                           34.29
      KM  (MEASURED)                           1.84

  TEST NUMBER,                                2A1N43
  BAROMETER,            MM HG                  744.2
  HUMIDITY,             G/KG                    10.9
  TEMPERATURE,          DEG C                   24.4
   CARBON DIOXIDE,       G/KM                  569.7
  FUEL CONSUMPTION,     L/100KM                21.78

  HYDROCARBONS,         G/KM                     .29
  CARBON MONOXIDE,      G/KM                    1.60
  OXIDES OF NITROGEN,   G/KM                    1.45
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SUMMARY OF REGULATED EMISSIONS FROM 1981 OLDSMOBILE CUTLASS
DIESEL VEHICLE USING EM-469-F FUEL

Test Code	2A2F18	2A2F22	2A2F26	2A2F30	2A2F34	2A2H19	2A2H23	2A2H27	2A2H31
Test Type	3-b FTP	3-b FTP	3-b FTP	3-b FTP	3-b FTP	HFET	HFET	HFET	HFET
Date (1981)	6/4	6/5	6/19	6/22	6/23	6/4	6/5	6/19	6/22
Run No.	1	2	3	4	5	1	2	3	4
HC, g/mi	0.21	0.21	0.24	0.19	0.21	0.16	0.14	0.16	0.18
CO, g/mi	1.14	1.09	1.05	1.17	1.11	0.74	0.72	0.69	0.74
NO_x, g/mi	1.05	1.08	1.01	1.01	1.09	0.58	0.63	0.60	0.61
Part., g/mi	0.42	0.46	0.46	0.43	0.43	0.20	0.21	0.20	0.21
Fuel, mi/gal	22.4	22.2	21.8	22.1	21.9	34.3	32.0	32.1	32.5

Test Code	2A2N20	2A2N24	2A2N28	2A2N32	2A2N35	2A2N36	2A2S21	2A2S25	2A2S29	2A2S33
Test Type	NYCC	NYCC	NYCC	NYCC	NYCC	NYCC	85 kph	85 kph	85 kph	85 kph
Date (1981)	6/4	6/5	6/19	6/22	6/23	6/23	6/4	6/5	6/19	6/22
Run No.	1	2	3	4	5	6	1	2	3	4
HC, g/mi	0.53	0.47	0.51	0.48	0.58	0.56	0.14	0.14	0.13	0.11
CO, g/mi	2.46	2.41	2.37	2.61	2.56	2.67	0.77	0.71	0.66	0.66
NO_x, g/mi	2.41	2.43	2.41	2.35	2.37	2.40	0.58	0.60	0.56	0.58
Part., g/mi	0.73	0.70	0.59	0.68	0.62	0.61	0.14	0.15	0.13	0.14
Fuel, mi/gal	11.4	11.2	11.2	11.1	11.8	11.2	34.8	32.7	33.1	33.4

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                                         FTP    VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.   2A2F18   RUN   1                       VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                   DATE    6/ 4/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                        BAG CART NO. 1 / CVS NO.  3          DIESEL    EM-469-F
TRANSMISSION A3                                   DYNO NO.       2                     ODOMETER  4595. KM( 2855. MILES)

BAROMETER 736.35 MM HG(28.99 IN HG)               DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  57. PCT                        ABS. HUMIDITY 12.5 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.06
BAG RESULTS
  BAG NUMBER                                          1                  2                  3                  4
  DESCRIPTION                                   COLD TRANSIENT       STABILIZED       HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)                 690.9 (27.2)       693.4 (27.3)       690.9 (27.2)       690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)               561.3 (22.1)       563.9 (22.2)       561.3 (22.1)       561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)              35.0 ( 95.0)       33.3 ( 92.0)       35.6 ( 96.0)       33.9 ( 93.0)
  BLOWER REVOLUTIONS                               13839.             23812.             13843.             23814.
  TOT FLOW STD. CU. METRES(SCF)                 134.2 ( 4738.)     231.5 ( 8176.)     134.1 ( 4736.)     231.4 ( 8171.)
  HC  SAMPLE METER/RANGE/PPM                    12.4/11/  12.      10.6/11/  11.      14.6/11/  15.      10.9/11/  11.
  HC  BCKGRD METER/RANGE/PPM                     5.8/ 1/   6.       4.6/ 1/   5.       4.6/ 1/   5.       4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                    32.2/13/  30.      20.2/13/  18.      27.7/13/  25.      19.5/13/  18.
  CO  BCKGRD METER/RANGE/PPM                     1.6/13/   1.       1.5/13/   1.       1.4/13/   1.       1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    42.7/ 3/  .73      28.6/ 3/  .47      37.2/ 3/  .63      27.5/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT                     3.2/ 3/  .05       3.1/ 3/  .05       3.1/ 3/  .05       3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    12.6/ 2/  13.      10.1/ 2/  10.      11.6/ 2/  12.      10.0/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                      .5/ 2/   1.        .5/ 2/   1.        .4/ 2/   0.        .4/ 2/   0.
  DILUTION FACTOR                                  18.30              28.29              21.27              29.50
  HC  CONCENTRATION PPM                             7.                 6.                10.                 7.
  CO  CONCENTRATION PPM                            27.                17.                23.                16.
  CO2 CONCENTRATION PCT                            .68                .43                .58                .41
  NOX CONCENTRATION PPM                           12.1                9.6               11.2                9.6
  HC  MASS GRAMS                                   .53                .82                .79                .88
  CO  MASS GRAMS                                  4.28               4.48               3.66               4.42
  CO2 MASS GRAMS                                1675.0             1801.7             1426.0             1718.0
  NOX MASS GRAMS                                  3.31               4.53               3.06               4.53
  PARTICULATE MASS GRAMS                          1.94               1.50               1.36               1.33

  HC  GRAMS/KM                                     .09                .13                .14                .14
  CO  GRAMS/KM                                     .74                .73                .64                .72
  CO2 GRAMS/KM                                   291.0              293.7              249.4              279.6
  NOX GRAMS/KM                                     .58                .74                .54                .74
  FUEL CONSUMPTION BY CB L/100KM                 10.86              10.96               9.31              10.44

  RUN TIME                    SECONDS            505.               868.               505.               868.
  MEASURED DISTANCE           KM                 5.76               6.13               5.72               6.14
  SCF, DRY                                       .975               .977               .976               .977
      DFC, WET (DRY)                                     .958 ( .940)                          .961 ( .944)
      SCF, WET (DRY)                                    1.000 ( .976)                         1.000 ( .977)
      VOL (SCM)                                                365.7                                 365.5
      SAM BLR (SCM)                                            77.25                                 77.29
      KM  (MEASURED)                                           11.89                                 11.86
      FUEL CONSUMPTION L/100KM                                 10.91                                  9.90

COMPOSITE RESULTS
  TEST NUMBER            2A2F18                                                              3-BAG      (4-BAG)
  BAROMETER     MM HG    736.3                          CARBON DIOXIDE       G/KM            280.9      ( 276.8)
  HUMIDITY      G/KG      12.5                          FUEL CONSUMPTION     L/100KM         10.49      ( 10.33)
  TEMPERATURE   DEG C     26.1                          HYDROCARBONS (THC)   G/KM              .13      (   .13)
                                                        CARBON MONOXIDE      G/KM              .71      (   .70)
                                                        OXIDES OF NITROGEN   G/KM              .65      (   .65)
                                                        PARTICULATES         G/KM             .262      (  .254)
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                              HFET   VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001

TEST NO.   2A2H19   RUN   1                      VEHICLE NO.2A                    TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                  DATE    6/ 4/81                  ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                       BAG CART NO.  1                  DIESEL    EM-469-F
TRANSMISSION A3                                  DYNO NO.       2                 ODOMETER  4617. KM( 2869. MILES)
                                                 CVS NO.   3

BAROMETER 736.09 MM HG(28.98 IN HG)              DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  51. PCT                       ABS. HUMIDITY 11.5 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
   TEST CYCLE                                        HFET

  BLOWER DIF P MM. H2O(IN. H2O)                690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)              561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)             35.6 ( 96.0)
  BLOWER REVOLUTIONS                               21007.
  TOT FLOW STD. CU. METRES(SCF)                203.3 ( 7178.)
  HC  SAMPLE METER/RANGE/PPM                   17.8/11/  18.
  HC  BCKGRD METER/RANGE/PPM                    4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                   35.9/13/  33.
  CO  BCKGRD METER/RANGE/PPM                     .7/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   48.8/ 3/  .84
  CO2 BCKGRD METER/RANGE/PCT                    3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   15.0/ 2/  15.
  NOX BCKGRD METER/RANGE/PPM                     .4/ 2/   0.
  DILUTION FACTOR                                  15.78
  HC  CONCENTRATION PPM                             14.
  CO  CONCENTRATION PPM                             32.
  CO2 CONCENTRATION PCT                             .80
  NOX CONCENTRATION PPM                            14.6
  HC  MASS GRAMS                                    1.59
  CO  MASS GRAMS                                    7.47
  CO2 MASS GRAMS                                 2981.3
  NOX MASS GRAMS                                    5.85
  PARTICULATE MASS GRAMS                            1.97
  RUN TIME                 SECONDS                 765.
       DFC, WET (DRY)                          .937 ( .921)
       SCF, WET (DRY)                         1.000 ( .976)
       VOL (SCM)                                  203.3
       SAM BLR (SCM)                              42.90
       KM  (MEASURED)                             16.24

  TEST NUMBER,                                  2A2H19
  BAROMETER,             MM HG                   736.1
  HUMIDITY,              G/KG                     11.5
  TEMPERATURE,           DEG C                    26.7
   CARBON DIOXIDE,        G/KM                   183.6
  FUEL CONSUMPTION,      L/100KM                  6.86

  HYDROCARBONS,          G/KM                      .10
  CARBON MONOXIDE,       G/KM                      .46
  OXIDES OF NITROGEN,    G/KM                      .36
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                                      NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A2N20   RUN   1                      VEHICLE NO.2A                     TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                  DATE    6/ 4/81                   ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                       BAG CART NO.  1                   DIESEL    EM-469-F
TRANSMISSION A3                                  DYNO NO.      2                   ODOMETER  4633. KM( 2879. MILES)
                                                 CVS NO.   3

BAROMETER 736.35 MM HG(28.99 IN HG)              DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  54. PCT                       ABS. HUMIDITY 11.8 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.04
BAG RESULTS
  TEST CYCLE                                        NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                  690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)                561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)               33.3 ( 92.0)
  BLOWER REVOLUTIONS                               16478.
  TOT FLOW STD. CU. METRES(SCF)                  160.3 ( 5661.)
  HC  SAMPLE METER/RANGE/PPM                     11.2/11/  11.
  HC  BCKGRD METER/RANGE/PPM                      4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                     18.1/13/  16.
  CO  BCKGRD METER/RANGE/PPM                       .6/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                     24.5/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                      2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                      9.6/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                       .7/ 2/   1.
  DILUTION FACTOR                                    33.36
  HC  CONCENTRATION PPM                                7.
  CO  CONCENTRATION PPM                               16.
  CO2 CONCENTRATION PCT                               .36
  NOX CONCENTRATION PPM                               8.9
  HC  MASS GRAMS                                       .62
  CO  MASS GRAMS                                      2.90
  CO2 MASS GRAMS                                   1044.6
  NOX MASS GRAMS                                      2.84
  PARTICULATE MASS GRAMS                               .86
  RUN TIME                  SECONDS                  600.
       DFC, WET (DRY)                             .970 ( .953)
       SCF, WET (DRY)                            1.000 ( .979)
       VOL (SCM)                                    160.3
       SAM BLR (SCM)                                 33.83
       KM  (MEASURED)                                1.89

  TEST NUMBER,                                    2A2N20
  BAROMETER,             MM HG                     736.3
  HUMIDITY,              G/KG                       11.8
  TEMPERATURE,           DEG C                      26.1
   CARBON DIOXIDE,        G/KM                      552.7
  FUEL CONSUMPTION,      L/100KM                    20.65

  HYDROCARBONS,          G/KM                        .33
  CARBON MONOXIDE,       G/KM                       1.53
  OXIDES OF NITROGEN,    G/KM                       1.50
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                                          85 KPH VEHICLE EMISSIONS RESULTS
                                               PROJECT 05-4874-001

TEST NO.   2A2S21   RUN   1                   VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE    6/ 4/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO.  1                      DIESEL     EM-469-F
TRANSMISSION A3                               DYNO NO.      2                      ODOMETER  4635. KM( 2880. MILES)
                                              CVS NO.   3

BAROMETER 736.35 MM HG(28.99 IN HG)           DRY BULD TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  51. PCT                    ABS. HUMIDITY 11.5 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  TEST CYCLE                                     85 K

  BLOWER DIF P MM. H2O(IN. H2O)               690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)             561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.2 ( 99.0)
  BLOWER REVOLUTIONS                            32943.
  TOT FLOW STD. CU. METRES(SCF)               318.2 (11234.)
  HC  SAMPLE METER/RANGE/PPM                  18.3/11/  10.
  HC  BCKGRD METER/RANGE/PPM                   4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                  40.7/13/  38.
  CO  BCKGRD METER/RANGE/PPM                    .2/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                  52.8/ 3/  .92
  CO2 BCKGRD METER/RANGE/PCT                   2.7/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                  16.7/ 2/  17.
  NOX BCKGRD METER/RANGE/PPM                    .6/ 2/   1.
  DILUTION FACTOR                                14.46
  HC  CONCENTRATION PPM                           14.
  CO  CONCENTRATION PPM                           36.
  CO2 CONCENTRATION PCT                           .88
  NOX CONCENTRATION PPM                          16.1
  HC  MASS GRAMS                                   2.57
  CO  MASS GRAMS                                 13.50
  CO2 MASS GRAMS                               5143.1
  NOX MASS GRAMS                                 10.10
  PARTICULATE MASS GRAMS                           2.42
  RUN TIME                  SECONDS             1200.
     DFC, WET (DRY)                            .931 ( .916)
     SCF, WET (DRY)                           1.000 ( .975)
     VOL (SCM)                                  318.2
     SAM BLR (SCM)                               67.35
     KM  (MEASURED)                              28.40

  TEST NUMBER,                                  2A2S21
  BAROMETER,            MM HG                    736.3
  HUMIDITY,             G/KG                      11.5
  TEMPERATURE,          DEG C                     26.7
   CARBON DIOXIDE,       G/KM                    181.1
  FUEL CONSUMPTION,     L/100KM                    6.76

  HYDROCARBONS,         G/KM                       .09
  CARBON MONOXIDE,      G/KM                       .48
  OXIDES OF NITROGEN,   G/KM                       .36
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                                              FTP     VEHICLE EMISSIONS RESULTS
                                                        PROJECT 05-4874-001

TEST NO.    2A2F22    RUN    2                       VEHICLE NO.2A                             TEST WEIGHT   1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDS CUTLASS                     DATE     6/ 5/81                          ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                           BAG CART NO. 1 / CVS NO.  3               DIESEL     EM 469-F
TRANSMISSION A3                                      DYNO NO.        2                         ODOMETER   4667. KM( 2900. MILES)

BAROMETER 736.35 MM HG(28.99 IN HG)                  DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY   60. PCT                          ABS. HUMIDITY 12.8 GM/KG                  NOX HUMIDITY CORRECTION FACTOR  1.07
BAG RESULTS
   BAG NUMBER                                   1                       2                     3                       4
   DESCRIPTION                           COLD TRANSIENT            STABILIZED           HOT TRANSIENT             STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)         693.4 (27.3)            690.9 (27.2)          690.9 (27.2)            690.9 (27.2)
   BLOWER INLET P MM. H2O(IN. H2O)       561.3 (22.1)            561.3 (22.1)          561.3 (22.1)            561.3 (22.1)
   BLOWER INLET TEMP. DEG. C(DEG. F)      34.4 ( 94.0)            33.3 ( 92.0)          34.4 ( 94.0)            33.3 ( 92.0)
   BLOWER REVOLUTIONS                      13856.                  23817.                13852.                  23820.
   TOT FLOW STD. CU. METRES(SCF)         134.5 ( 4749.)          231.7 ( 8182.)        134.5 ( 4750.)          231.8 ( 8185.)
   HC  SAMPLE METER/RANGE/PPM            16.6/11/  17.           10.6/11/  11.         14.3/11/  14.           10.8/11/  11.
   HC  BCKGRD METER/RANGE/PPM             5.1/ 1/   5.            5.0/ 1/   5.          5.0/ 1/   5.            4.7/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM            33.5/13/  31.           21.4/13/  20.         27.5/13/  25.           19.7/13/  18.
   CO  BCKGRD METER/RANGE/PPM             4.0/13/   4.            3.3/13/   3.          2.1/13/   2.            2.1/13/   2.
   CO2 SAMPLE METER/RANGE/PCT            42.6/ 3/  .73           28.8/ 3/  .47         38.6/ 3/  .65           27.2/ 3/  .45
   CO2 BCKGRD METER/RANGE/PCT             3.1/ 3/  .05            2.9/ 3/  .04          3.1/ 3/  .05            3.0/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM            12.4/ 2/  12.           10.5/ 2/  11.         12.1/ 2/  12.           10.7/ 2/  11.
   NOX BCKGRD METER/RANGE/PPM              .6/ 2/   1.             .6/ 2/   1.           .4/ 2/   0.             .8/ 2/   1.
   DILUTION FACTOR                         18.33                   28.08                20.44                   29.85
   HC  CONCENTRATION PPM                   12.                      6.                  10.                      6.
   CO  CONCENTRATION PPM                   27.                     16.                  23.                     16.
   CO2 CONCENTRATION PCT                   .68                     .43                  .61                     .40
   NOX CONCENTRATION PPM                  11.8                     9.9                 11.7                     9.9
   HC  MASS GRAMS                          .91                     .77                  .74                     .83
   CO  MASS GRAMS                         4.16                    4.35                 3.55                    4.22
   CO2 MASS GRAMS                       1678.1                  1830.8               1494.0                  1705.0
   NOX MASS GRAMS                         3.27                    4.72                 3.24                    4.72
   PARTICULATE MASS GRAMS                 2.29                    1.61                 1.50                    1.24

   HC  GRAMS/KM                            .16                     .13                  .13                     .13
   CO  GRAMS/KM                            .72                     .70                  .61                     .68
   CO2 GRAMS/KM                          289.9                   295.7                258.6                   275.3
   NOX GRAMS/KM                            .56                     .76                  .56                     .76
   FUEL CONSUMPTION BY CB L/100KM        10.82                   11.04                 9.65                   10.28

   RUN TIME                  SECONDS      505.                    868.                 505.                    868.
   MEASURED DISTANCE         KM           5.79                    6.19                 5.78                    6.19
   SCF, DRY                               .974                    .976                 .975                    .976
         DFC, WET (DRY)                          .957 ( .939)                                   .961 ( .942)
         SCF, WET (DRY)                         1.000 ( .975)                                  1.000 ( .976)
         VOL (SCM)                                     366.2                                          366.3
         SAM BLR (SCM)                                 77.40                                          77.51
         KM  (MEASURED)                                11.98                                          11.97
         FUEL CONSUMPTION L/100KM                      10.93                                           9.98

COMPOSITE RESULTS
   TEST NUMBER             2A2F22                                                                   3-BAG        (4-BAG)
   BAROMETER     MM HG     736.3                            CARBON DIOXIDE          G/KM            284.3      ( 278.3)
   HUMIDITY      G/KG       12.8                            FUEL CONSUMPTION        L/100KM         10.61      ( 10.39)
   TEMPERATURE   DEG C.     25.6                            HYDROCARBONS (THC)      G/KM              .13      (   .14)
                                                            CARBON MONOXIDE         G/KM              .68      (   .68)
                                                            OXIDES OF NITROGEN      G/KM              .67      (   .67)
                                                            PARTICULATES            G/KM             .288      (  .271)
                                              HFET   VEHICLE EMISSIONS RESULTS
                                                       PROJECT 05-4874-001

TEST NO.   2A2H23   RUN   2                      VEHICLE NO.2A                  TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                  DATE    6/ 5/81                ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                       BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION A3                                  DYNO NO.      2                ODOMETER  4691. KM( 2915. MILES)
                                                 CVS NO.   3

BAROMETER 736.60 MM HG(29.00 IN HG)              DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  54. PCT                       ABS. HUMIDITY 12.3 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.06
BAG RESULTS
   TEST CYCLE                                       HFET

   BLOWER DIF P MM. H2O(IN. H2O)                 690.9 (27.2)
   BLOWER INLET P MM. H2O(IN. H2O)               561.3 (22.1)
   BLOWER INLET TEMP. DEG. C(DEG. F)              36.7 ( 98.0)
   BLOWER REVOLUTIONS                              21001.
   TOT FLOW STD. CU. METRES(SCF)                 203.2 ( 7176.)
   HC  SAMPLE METER/RANGE/PPM                    16.9/11/  17.
   HC  BCKGRD METER/RANGE/PPM                     5.2/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                    36.4/13/  34.
   CO  BCKGRD METER/RANGE/PPM                     1.5/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                    52.3/ 3/  .91
   CO2 BCKGRD METER/RANGE/PCT                     2.7/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM                    16.5/ 2/  17.
   NOX BCKGRD METER/RANGE/PPM                      .9/ 2/   1.
   DILUTION FACTOR                                  14.62
   HC  CONCENTRATION PPM                             12.
   CO  CONCENTRATION PPM                             31.
   CO2 CONCENTRATION PCT                             .87
   NOX CONCENTRATION PPM                            15.7
   HC  MASS GRAMS                                    1.41
   CO  MASS GRAMS                                    7.40
   CO2 MASS GRAMS                                 3249.1
   NOX MASS GRAMS                                    6.42
   PARTICULATE MASS GRAMS                            2.14
   RUN TIME                 SECONDS                 765.
        DFC, WET (DRY)                           .932 ( .915)
        SCF, WET (DRY)                          1.000 ( .974)
        VOL (SCM)                                  203.2
        SAM BLR (SCM)                               43.12
        KM  (MEASURED)                              16.52

   TEST NUMBER,                                   2A2H23
   BARONETER,              MM HG                   736.6
   HUMIDITY,               G/KG                     12.3
   TEMPERATURE,            DEG C                    26.7
    CARBON DIOXIDE,         G/KM                   196.7
   FUEL CONSUMPTION,       L/100KM                  7.34

   HYDROCARBONS,           G/KM                      .09
   CARBON MONOXIDE,        G/KM                      .45
   OXIDES OF NITROGEN,     G/KM                      .39
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A2N24   RUN   2                 VEHICLE NO.2A                  TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS             DATE    6/ 5/81                 CTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                  BAG CART NO.  1                DIESEL    EM-469-F
TRANSMISSION A3                             DYNO NO.      2                ODOMETER  4707. KM( 2925. MILES)
                                            CVS NO.   3

BAROMETER 736.60 MM HG(29.00 IN HG)         DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  54. PCT                  ABS. HUMIDITY 11.8 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.04
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)             690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)           561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)          32.8 ( 91.0)
  BLOWER REVOLUTIONS                          16476.
  TOT FLOW STD. CU. METRES(SCF)             160.7 ( 5674.)
  HC  SAMPLE METER/RANGE/PPM                10.8/11/  11.
  HC  BCKGRD METER/RANGE/PPM                 5.1/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                18.4/13/  17.
  CO  BCKGRD METER/RANGE/PPM                 1.4/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                24.8/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                 3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 9.7/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                  .8/ 2/   1.
  DILUTION FACTOR                                32.94
  HC  CONCENTRATION PPM                           6.
  CO  CONCENTRATION PPM                          15.
  CO2 CONCENTRATION PCT                          .36
  NOX CONCENTRATION PPM                          8.9
  HC  MASS GRAMS                                 .54
  CO  MASS GRAMS                                2.83
  CO2 MASS GRAMS                              1058.0
  NOX MASS GRAMS                                2.84
  PARTICULATE MASS GRAMS                         .82
  RUN TIME              SECONDS                 600.
       DFC, WET (DRY)                       .970 ( .953)
       SCF, WET (DRY)                      1.000 ( .979)
       VOL (SCM)                               160.7
       SAM BLR (SCM)                           34.01
       KM  (MEASURED)                           1.88

  TEST NUMBER,                                2A2N24
  BAROMETER,            MM HG                  736.6
  HUMIDITY,             G/KG                    11.8
  TEMPERATURE,          DEG C                   26.1
   CARBON DIOXIDE,       G/KM                  561.6
  FUEL CONSUMPTION,     L/100KM                20.97

  HYDROCARBONS,         G/KM                     .29
  CARBON MONOXIDE,      G/KM                    1.50
  OXIDES OF NITROGEN,   G/KM                    1.51
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                                   85 KPH VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001

TEST NO.   2A2S25   RUN   2                   VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE     6/ 5/81                   ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO.  1                    DIESEL     EM-469-F
TRANSMISSION A3                               DYNO NO.      2                    ODOMETER  4709. KM( 2926. MILES)
                                              CVS NO.   3

BAROMETER 736.60 MM HG(29.00 IN HG)           DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  51. PCT                    ABS. HUMIDITY 11.5 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
   TEST CYCLE                                    85 K

   BLOWER DIF P MM. H2O(IN. H2O)              690.9 (27.2)
   BLOWER INLET P MM. H2O(IN. H2O)            561.3 (22.1)
   BLOWER INLET TEMP. DEG. C(DEG. F)           38.3 (101.0)
   BLOWER REVOLUTIONS                            32965.
   TOT FLOW STD. CU. METRES(SCF)              318.0 (11229.)
   HC  SAMPLE METER/RANGE/PPM                 18.3/11/  18.
   HC  BCKGRD METER/RANGE/PPM                  5.4/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                 39.3/13/  37.
   CO  BCKGRD METER/RANGE/PPM                  1.2/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                 56.3/ 3/  .99
   CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                 17.5/ 2/  18.
   NOX BCKGRD METER/RANGE/PPM                   .9/ 2/   1.
   DILUTION FACTOR                               13.47
   HC  CONCENTRATION PPM                           13.
   CO  CONCENTRATION PPM                           34.
   CO2 CONCENTRATION PCT                           .94
   NOX CONCENTRATION PPM                          16.7
   HC  MASS GRAMS                                 2.43
   CO  MASS GRAMS                                12.68
   CO2 MASS GRAMS                               5490.3
   NOX MASS GRAMS                                10.42
   PARTICULATE MASS GRAMS                         2.65
   RUN TIME              SECONDS                 1201.
       DFC, WET (DRY)                         .926 ( .910)
       SCF, WET (DRY)                        1.000 ( .974)
       VOL (SCM)                                 318.0
       SAM BLR (SCM)                             67.52
       KM  (MEASURED)                            28.51

   TEST NUMBER,                                 2A2S25
   BAROMETER,            MM HG                   736.6
   HUMIDITY,             G/KG                     11.5
   TEMPERATURE,          DEG C                    26.7
    CARBON DIOXIDE,       G/KM                   192.6
   FUEL CONSUMPTION,     L/100KM                  7.19

   HYDROCARBONS,         G/KM                      .09
   CARBON MONOXIDE,      G/KM                      .44
   OXIDES OF NITROGEN,   G/KM                      .37
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                                    FTP    VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.   2A2F26   RUN   3                   VEHICLE NO.2A                      TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE    6/19/81                    ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO. 1 / CVS NO.  3        DIESEL     EM-469-F
TRANSMISSION A3                               DYNO NO.       2                   ODOMETER  4756. KM( 2955. MILES)

BAROMETER 741.93 MM HG(29.21 IN HG)           DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY  58. PCT                    ABS. HUMIDITY 10.7 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   BAG NUMBER                                    1                  2                  3                  4
   DESCRIPTION                             COLD TRANSIENT      STABILIZED        HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)           703.6 (27.7)       708.7 (27.9)       708.7 (27.9)       711.2 (28.0)
   BLOWER INLET P MM. H2O(IN. H2O)         563.9 (22.2)       569.0 (22.4)       569.0 (22.4)       576.6 (22.7)
   BLOWER INLET TEMP. DEG. C(DEG. F)        35.0 ( 95.0)       31.7 ( 89.0)       35.0 ( 95.0)       32.2 ( 90.0)
   BLOWER REVOLUTIONS                         13851.             23809.             13839.             23819.
   TOT FLOW STD. CU. METRES(SCF)           135.6 ( 4789.)     234.7 ( 8286.)     135.5 ( 4783.)     234.3 ( 8274.)
   HC  SAMPLE METER/RANGE/PPM              16.2/11/  16.      11.4/11/  11.      14.8/11/  15.      12.6/11/  13.
   HC  BCKGRD METER/RANGE/PPM               6.1/ 1/   6.       4.3/ 1/   4.       4.3/ 1/   4.       5.5/ 1/   6.
   CO  SAMPLE METER/RANGE/PPM              32.7/13/  30.      20.6/13/  19.      27.6/13/  25.      19.3/13/  18.
   CO  BCKGRD METER/RANGE/PPM               4.9/13/   4.       4.0/13/   4.       2.7/13/   2.       2.1/13/   2.
   CO2 SAMPLE METER/RANGE/PCT              43.6/ 3/  .75      28.8/ 3/  .47      39.3/ 3/  .66      28.4/ 3/  .47
   CO2 BCKGRD METER/RANGE/PCT               3.1/ 3/  .05       3.3/ 3/  .05       3.2/ 3/  .05       3.3/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM              12.7/ 2/  13.      10.1/ 2/  10.      12.4/ 2/  12.      10.6/ 2/  11.
   NOX BCKGRD METER/RANGE/PPM                .2/ 2/   0.        .3/ 2/   0.        .5/ 2/   1.        .5/ 2/   1.
   DILUTION FACTOR                            17.88              28.07              20.04              28.50
   HC  CONCENTRATION PPM                       10.                 7.                11.                 7.
   CO  CONCENTRATION PPM                       25.                15.                22.                15.
   CO2 CONCENTRATION PCT                       .70                .43                .62                .42
   NOX CONCENTRATION PPM                      12.5                9.8               11.9               10.1
   HC  MASS GRAMS                              .82                .99                .84                .99
   CO  MASS GRAMS                             3.96               4.05               3.51               4.17
   CO2 MASS GRAMS                           1739.1             1828.4             1533.2             1795.3
   NOX MASS GRAMS                             3.24               4.40               3.09               4.53
   PARTICULATE MASS GRAMS                     2.06               1.80               1.30               1.46

   HC  GRAMS/KM                                .14                .16                .15                .16
   CO  GRAMS/KM                                .69                .66                .61                .67
   CO2 GRAMS/KM                              301.1              295.8              265.6              288.7
   NOX GRAMS/KM                                .56                .71                .53                .73
   FUEL CONSUMPTION BY CB L/100KM            11.24              11.04               9.92              10.78

   RUN TIME                SECONDS            505.               868.               504.               868.
   MEASURED DISTANCE       KM                 5.78               6.18               5.77               6.22
   SCF, DRY                                   .974               .977               .975               .977
        DFC, WET (DRY)                                 .957 ( .939)                          .959 ( .941)
        SCF, WET (DRY)                                1.000 ( .976)                         1.000 ( .976)
        VOL (SCM)                                             370.3                                 369.8
        SAM BLR (SCM)                                         78.36                                 78.39
        KM  (MEASURED)                                        11.96                                 11.99
        FUEL CONSUMPTION L/100KM                              11.14                                 10.36

COMPOSITE RESULTS
   TEST NUMBER            2A2F26                                                           3-BAG        (4-BAG)
   BAROMETER    MM HG    741.9                        CARBON DIOXIDE        G/KM           288.6       ( 286.5)
   HUMIDITY     G/KG      10.7                        FUEL CONSUMPTION      L/100KM        10.77       ( 10.70)
   TEMPERATURE  DEG C     23.3                        HYDROCARBONS (THC)    G/KM             .15       (   .15)
                                                      CARBON MONOXIDE       G/KM             .65       (   .65)
                                                      OXIDES OF NITROGEN    G/KM             .63       (   .64)
                                                      PARTICULATES          G/KM            .287       (  .270)
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                                                 HFET   VEHICLE EMISSIONS RESULTS
                                                          PROJECT 05-4874-001

TEST NO.    2A2H27    RUN    3                        VEHICLE NO.2A
VEHICLE MODEL    81 OLDS CUTLASS                      DATE     6/19/81                     TEST WEIGHT   1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8                            BAG CART NO.  1                      ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
TRANSMISSION A3                                       DYNO NO.      2                      DIESEL     EM-469-F
                                                      CVS NO.    3                         ODOMETER  4780. KM( 2970. MILES)

BAROMETER 741.93 MM HG(29.21 IN HG)                   DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  56. PCT                            ABS. HUMIDITY 10.9 GM/KG
BAG RESULTS                                                                                NOX HUMIDITY CORRECTION FACTOR  1.01
   TEST CYCLE                                             HFET

  BLOWER DIF P MM. H2O(IN. H2O)                       703.6 (27.7)
  BLOWER INLET P MM. H2O(IN. H2O)                     571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)                    37.2 ( 99.0)
  BLOWER REVOLUTIONS                                      20996.
  TOT FLOW STD. CU. METRES(SCF)                       204.7 ( 7227.)
  HC  SAMPLE METER/RANGE/PPM                          18.4/11/  18.
  HC  BCKGRD METER/RANGE/PPM                           5.3/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                          34.6/13/  32.
  CO  BCKGRD METER/RANGE/PPM                           1.3/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                          52.2/ 3/  .91
  CO2 BCKGRD METER/RANGE/PCT                           3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                          15.9/ 2/  16.
  NOX BCKGRD METER/RANGE/PPM                            .5/ 2/   1.
  DILUTION FACTOR                                         14.65
  HC  CONCENTRATION PPM                                     13.
  CO  CONCENTRATION PPM                                     30.
  CO2 CONCENTRATION PCT                                     .86
  NOX CONCENTRATION PPM                                    15.4
  HC  MASS GRAMS                                           1.58
  CO  MASS GRAMS                                           7.09
  CO2 MASS GRAMS                                         3227.0
  NOX MASS GRAMS                                           6.08
  PARTICULATE MASS GRAMS                                   2.03
  RUN TIME                  SECONDS                        765.
       DFC, WET (DRY)                                  .932 ( .915)
       SCF, WET (DRY)                                 1.000 ( .974)
       VOL (SCM)                                          204.7
       SAM BLR (SCM)                                      43.60
       KM  (MEASURED)                                     16.43

  TEST NUMBER,                                           2A2H27
  BAROMETER,             MM HG                            741.9
  HUMIDITY,              G/KG                              10.9
  TEMPERATURE,           DEG C                             24.4
   CARBON DIOXIDE,        G/KM                            196.4
  FUEL CONSUMPTION,      L/100KM                           7.33

  HYDROCARBONS,          G/KM                               .10
  CARBON MONOXIDE,       G/KM                               .43
  OXIDES OF NITROGEN,    G/KM                               .37
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.    2A2N28    RUN    3                   VEHICLE NO.2A                    TEST WEIGHT   1814. KG( 4000. LBS)
VEHICLE MODEL    81 OLDS CUTLASS                 DATE      6/19/81                ACTUAL ROAD LOAD    8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                       BAG CART NO.  1                  DIESEL      EM-469-F
TRANSMISSION A3                                  DYNO NO.      2                  ODOMETER  4796. KM( 2980. MILES)
                                                 CVS NO.   3

BAROMETER 741.68 MM HG(29.20 IN HG)              DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  55. PCT                       ABS. HUMIDITY 10.5 GM/KG
BAG RESULTS                                                                       NOX HUMIDITY CORRECTION FACTOR    .99
  TEST CYCLE                                       NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                 703.6 (27.7)
  BLOWER INLET P MM. H2O(IN. H2O)               571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)              33.9 ( 93.0)
  BLOWER REVOLUTIONS                               16470.
  TOT FLOW STD. CU. METRES(SCF)                 161.4 ( 5701.)
  HC  SAMPLE METER/RANGE/PPM                    10.8/11/  11.
  HC  BCKGRD METER/RANGE/PPM                     4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                    17.7/13/  16.
  CO  BCKGRD METER/RANGE/PPM                     1.1/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    24.7/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                     3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                     9.6/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                      .4/ 2/   0.
  DILUTION FACTOR                                  33.08
  HC  CONCENTRATION PPM                              6.
  CO  CONCENTRATION PPM                             15.
  CO2 CONCENTRATION PCT                             .36
  NOX CONCENTRATION PPM                             9.2
  HC  MASS GRAMS                                    .60
  CO  MASS GRAMS                                   2.77
  CO2 MASS GRAMS                                 1053.3
  NOX MASS GRAMS                                   2.82
  PARTICULATE MASS GRAMS                            .69
  RUN TIME                  SECONDS                600.
       DFC, WET (DRY)                           .970 ( .953)
       SCF, WET (DRY)                          1.000 ( .979)
       VOL (SCM)                                   161.4
       SAM BLR (SCM)                               34.28
       KM  (MEASURED)                               1.88

 TEST NUMBER,                                   2A2N28
 BAROMETER,               MM HG                  741.7
 HUMIDITY,                G/KG                    10.5
 TEMPERATURE,             DEG C                   23.9
  CARBON DIOXIDE,          G/KM                   561.3
 FUEL CONSUMPTION,        L/100KM                20.97

 HYDROCARBONS,            G/KM                     .32
 CARBON MONOXIDE,         G/KM                    1.47
 OXIDES OF NITROGEN,      G/KM                    1.50
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                            85 KPH VEHICLE EMISSIONS RESULTS
                                  PROJECT 05-4874-001

TEST NO.   2A2S29   RUN   3              VEHICLE NO.2A                    TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS          DATE     6/19/81                 ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8               BAG CART NO.  1                  DIESEL     EM-469-F
TRANSMISSION A3                          DYNO NO.      2                  ODOMETER  4799. KM( 2982. MILES)
                                         CVS NO.   3

BAROMETER 741.68 MM HG(29.20 IN HG)      DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  53. PCT               ABS. HUMIDITY 10.7 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                               85 K

  BLOWER DIF P MM. H2O(IN. H2O)          701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)        563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)       38.9 (102.0)
  BLOWER REVOLUTIONS                        32885.
  TOT FLOW STD. CU. METRES(SCF)          319.3 (11273.)
  HC  SAMPLE METER/RANGE/PPM             16.9/11/  17.
  HC  BCKGRD METER/RANGE/PPM              5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM             35.5/13/  33.
  CO  BCKGRD METER/RANGE/PPM               .7/13/   1.
  CO2 SAMPLE METER/RANGE/PCT             55.5/ 3/  .97
  CO2 BCKGRD METER/RANGE/PCT              3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM             16.6/ 2/  17.
  NOX BCKGRD METER/RANGE/PPM               .5/ 2/   1.
  DILUTION FACTOR                           13.69
  HC  CONCENTRATION PPM                      12.
  CO  CONCENTRATION PPM                      31.
  CO2 CONCENTRATION PCT                      .93
  NOX CONCENTRATION PPM                     16.1
  HC  MASS GRAMS                             2.27
  CO  MASS GRAMS                            11.56
  CO2 MASS GRAMS                          5411.5
  NOX MASS GRAMS                             9.84
  PARTICULATE MASS GRAMS                     2.35
  RUN TIME                 SECONDS         1198.
      DFC, WET (DRY)                     .927 ( .911)
      SCF, WET (DRY)                    1.000 ( .974)
      VOL (SCM)                            319.3
      SAM BLR (SCM)                        67.96
      KM  (MEASURED)                       28.43

  TEST NUMBER,                            2A2S29
  BAROMETER,             MM HG             741.7
  HUMIDITY,              G/KG               10.7
  TEMPERATURE,           DEG C              25.0
   CARBON DIOXIDE,        G/KM             190.4
  FUEL CONSUMPTION,      L/100KM            7.10

  HYDROCARBONS,          G/KM                .08
  CARBON MONOXIDE,       G/KM                .41
  OXIDES OF NITROGEN,    G/KM                .35
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                                       FTP    VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   2A2F30   RUN   4                VEHICLE NO.2A                          TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS            DATE    6/22/81                        ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                 BAG CART NO. 1 / CVS NO.  3            DIESEL    EM-469-F
TRANSMISSION A3                            DYNO NO.       2                       ODOMETER  4854. KM( 3016. MILES)

BAROMETER 739.65 MM HG(29.12 IN HG)        DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  59. PCT                 ABS. HUMIDITY 11.2 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  BAG NUMBER                                      1                  2                  3                  4
  DESCRIPTION                              COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)            698.5 (27.5)       706.1 (27.8)       698.5 (27.5)       706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)          563.9 (22.2)       571.5 (22.5)       563.9 (22.2)       571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)         35.3 ( 95.5)       31.7 ( 89.0)       35.6 ( 96.0)       31.9 ( 89.5)
  BLOWER REVOLUTIONS                          13857.             23835.             13853.             23836.
  TOT FLOW STD. CU. METRES(SCF)            135.0 ( 4768.)     233.8 ( 8255.)     134.9 ( 4765.)     233.7 ( 8251.)
  HC  SAMPLE METER/RANGE/PPM               17.7/11/  18.      14.3/11/  14.      19.0/11/  19.      15.1/11/  15.
  HC  BCKGRD METER/RANGE/PPM                7.9/ 1/   8.      10.0/ 1/  10.      10.0/ 1/  10.       7.2/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM               34.3/13/  32.      21.6/13/  20.      29.1/13/  27.      20.7/13/  19.
  CO  BCKGRD METER/RANGE/PPM                2.9/13/   3.       2.6/13/   2.       1.8/13/   2.       1.5/13/   1.
  CO2 SAMPLE METER/RANGE/PCT               43.5/ 3/  .74      28.4/ 3/  .47      38.0/ 3/  .64      28.3/ 3/  .47
  CO2 BCKGRD METER/RANGE/PCT                3.4/ 3/  .05       3.0/ 3/  .05       2.9/ 3/  .04       3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM               12.5/ 2/  13.       9.7/ 2/  10.      12.1/ 2/  12.      10.3/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                 .1/ 2/   0.        .1/ 2/   0.        .4/ 2/   0.        .4/ 2/   0.
  DILUTION FACTOR                            17.91              28.47              20.77              28.58
  HC  CONCENTRATION PPM                      10.                 5.                10.                 8.
  CO  CONCENTRATION PPM                      28.                17.                24.                17.
  CO2 CONCENTRATION PCT                      .69                .42                .60                .42
  NOX CONCENTRATION PPM                     12.4                9.6               11.7                9.9
  HC  MASS GRAMS                             .80                .63                .74               1.09
  CO  MASS GRAMS                            4.43               4.61               3.83               4.64
  CO2 MASS GRAMS                          1715.7             1810.5             1478.5             1795.6
  NOX MASS GRAMS                            3.26               4.36               3.07               4.50
  PARTICULATE MASS GRAMS                    2.23               1.45               1.34               1.24

  HC  GRAMS/KM                               .14                .10                .13                .18
  CO  GRAMS/KM                               .77                .75                .67                .76
  CO2 GRAMS/KM                             298.9              294.6              258.2              293.2
  NOX GRAMS/KM                               .57                .71                .54                .74
  FUEL CONSUMPTION BY CB L/100KM           11.16              11.00               9.64              10.95

  RUN TIME             SECONDS              505.               868.               505.               869.
  MEASURED DISTANCE    KM                   5.74               6.14               5.73               6.12
  SCF, DRY                                  .974               .977               .975               .977
       DFC, WET (DRY)                               .957 ( .939)                          .960 ( .942)
       SCF, WET (DRY)                              1.000 ( .976)                         1.000 ( .976)
       VOL (SCM)                                         368.8                                 368.6
       SAM BLR (SCM)                                     77.94                                 77.97
       KM  (MEASURED)                                    11.89                                 11.85
       FUEL CONSUMPTION L/100KM                          11.08                                 10.32

COMPOSITE RESULTS                                                                          3-BAG       (4-BAG)
  TEST NUMBER            2A2F30                                   CARBON DIOXIDE     G/KM      285.5      ( 285.1)
  BAROMETER     MM HG    739.6                                    FUEL CONSUMPTION   L/100KM   10.66      ( 10.64)
  HUMIDITY      G/KG      11.2                                    HYDROCARBONS (THC) G/KM        .12      (   .14)
  TEMPERATURE   DEG C     23.9                                    CARBON MONOXIDE    G/KM        .73      (   .73)
                                                                  OXIDES OF NITROGEN G/KM        .63      (   .64)
                                                                  PARTICULATES       G/KM       .267      (  .258)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   2A2H31   RUN   4                 VEHICLE NO.2A                        TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS             DATE    6/22/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                  BAG CART NO.  1                      DIESEL    EM-469-F
TRANSMISSION A3                             DYNO NO.      2                      ODOMETER  4878. KM( 3031. MILES)
                                            CVS NO.   3

BAROMETER 739.65 MM HG(29.12 IN HG)         DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  59. PCT                  ABS. HUMIDITY 11.7 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  TEST CYCLE                                    HFET

  BLOWER DIF P MM. H2O(IN. H2O)             698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           561.3 (22.1)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)
  BLOWER REVOLUTIONS                           21016.
  TOT FLOW STD. CU. METRES(SCF)             204.5 ( 7220.)
  HC  SAMPLE METER/RANGE/PPM                21.0/11/  21.
  HC  BCKGRD METER/RANGE/PPM                 6.4/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                36.6/13/  34.
  CO  BCKGRD METER/RANGE/PPM                 1.3/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                51.5/ 3/  .90
  CO2 BCKGRD METER/RANGE/PCT                 3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                15.5/ 2/  16.
  NOX BCKGRD METER/RANGE/PPM                  .2/ 2/   0.
  DILUTION FACTOR                               14.86
  HC  CONCENTRATION PPM                         15.
  CO  CONCENTRATION PPM                         32.
  CO2 CONCENTRATION PCT                         .85
  NOX CONCENTRATION PPM                         15.3
  HC  MASS GRAMS                                1.77
  CO  MASS GRAMS                                7.52
  CO2 MASS GRAMS                              3178.3
  NOX MASS GRAMS                                6.19
  PARTICULATE MASS GRAMS                        2.13
  RUN TIME              SECONDS                 766.
     DFC, WET (DRY)                         .933 ( .915)
     SCF, WET (DRY)                        1.000 ( .973)
     VOL (SCM)                                 204.5
     SAM BLR (SCM)                             43.38
     KM  (MEASURED)                            16.39

  TEST NUMBER,                                2A2H31
  BAROMETER,            MM HG                  739.6
  HUMIDITY,             G/KG                    11.7
  TEMPERATURE,          DEG C                   24.4
   CARBON DIOXIDE,       G/KM                  193.9
  FUEL CONSUMPTION,     L/100KM                 7.24

  HYDROCARBONS,         G/KM                    .11
  CARBON MONOXIDE,      G/KM                    .46
  OXIDES OF NITROGEN,   G/KM                    .38
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A2N32   RUN   4                       VEHICLE NO.2A                     TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS                   DATE    6/22/81                   ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                        BAG CART NO.  1                   DIESEL     EM-469-F
TRANSMISSION A3                                   DYNO NO.      2                   ODOMETER  4894. KM( 3041. MILES)
                                                  CVS NO.   3

BAROMETER 739.65 MM HG(29.12 IN HG)               DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  55. PCT                        ABS. HUMIDITY 10.5 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                          NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                   698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)                 563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)                33.9 ( 93.0)
  BLOWER REVOLUTIONS                                 16448.
  TOT FLOW STD. CU. METRES(SCF)                   160.6 ( 5672.)
  HC   SAMPLE METER/RANGE/PPM                     11.9/11/  12.
  HC   BCKGRD METER/RANGE/PPM                      6.0/ 1/   6.
  CO   SAMPLE METER/RANGE/PPM                     19.6/13/  18.
  CO   BCKGRD METER/RANGE/PPM                      1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                      25.2/ 3/  .41
  CO2 BCKGRD METER/RANGE/PCT                       3.2/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                       9.4/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                        .4/ 2/   0.
  DILUTION FACTOR                                     32.37
  HC   CONCENTRATION PPM                                6.
  CO   CONCENTRATION PPM                               16.
  CO2 CONCENTRATION PCT                                .36
  NOX CONCENTRATION PPM                                9.0
  HC   MASS GRAMS                                       .56
  CO   MASS GRAMS                                     3.06
  CO2 MASS GRAMS                                    1069.4
  NOX MASS GRAMS                                      2.75
  PARTICULATE MASS GRAMS                               .80
  RUN TIME              SECONDS                      599.
       DFC, WET (DRY)                             .969 ( .952)
       SCF, WET (DRY)                            1.000 ( .978)
       VOL (SCM)                                   160.6
       SAM BLR (SCM)                               34.02
       KM  (MEASURED)                               1.88

  TEST NUMBER,                                    2A2N32
  BAROMETER,             MM HG                     739.6
  HUMIDITY,              G/KG                       10.5
  TEMPERATURE,           DEG C                      23.9
   CARBON DIOXIDE,        G/KM                     567.4
  FUEL CONSUMPTION,      L/100KM                   21.20

  HYDROCARBONS,          G/KM                        .30
  CARBON MONOXIDE,       G/KM                       1.62
  OXIDES OF NITROGEN,    G/KM                       1.46
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                                   85 KPH VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001
TEST NO.   2A2S33   RUN   4
VEHICLE MODEL   81 OLDS CUTLASS                VEHICLE NO.2A                       TEST WEIGHT  1814. KG( 4000. LBS)
ENGINE 5.7 L(350. CID) V-8                     DATE    6/22/81                     ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
TRANSMISSION A3                                BAG CART NO.  1                     DIESEL    EM-469-F
                                               DYNO NO.      2                     ODOMETER  4897. KM( 3043. MILES)
                                               CVS NO.   3

BAROMETER 739.65 MM HG(29.12 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  53. PCT                     ABS. HUMIDITY 10.7 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                     85 K

  BLOWER DIF P MM. H2O(IN. H2O)                690.9 (27.2)
  BLOWER INLET P MM. H2O(IN. H2O)              558.8 (22.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.2 ( 99.0)
  BLOWER REVOLUTIONS                             32944.
  TOT FLOW STD. CU. METRES(SCF)                320.3 (11310.)
  HC   SAMPLE METER/RANGE/PPM                  16.5/11/  16.
  HC   BCKGRD METER/RANGE/PPM                   5.7/ 1/   6.
  CO   SAMPLE METER/RANGE/PPM                  35.7/13/  33.
  CO   BCKGRD METER/RANGE/PPM                    .9/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                  54.6/ 3/  .96
  CO2  BCKGRD METER/RANGE/PCT                   3.0/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                  17.0/ 2/  17.
  NOX  BCKGRD METER/RANGE/PPM                    .5/ 2/   1.
  DILUTION FACTOR                                 13.94
  HC   CONCENTRATION PPM                          11.
  CO   CONCENTRATION PPM                          31.
  CO2  CONCENTRATION PCT                          .91
  NOX  CONCENTRATION PPM                         16.5
  HC   MASS GRAMS                                 2.07
  CO   MASS GRAMS                                11.61
  CO2  MASS GRAMS                              5359.0
  NOX  MASS GRAMS                                10.13
  PARTICULATE MASS GRAMS                          2.52
  RUN TIME              SECONDS                1200.
      DFC, WET (DRY)                           .928 ( .912)
      SCF, WET (DRY)                          1.000 ( .974)
      VOL (SCM)                                  320.3
      SAM BLR (SCM)                               67.88
      KM  (MEASURED)                              28.39

  TEST NUMBER,                                  2A2S33
  BARONETER,            MM HG                   739.6
  HUMIDITY,             G/KG                     10.7
  TEMPERATURE,          DEG C                    25.0
   CARBON DIOXIDE,       G/KM                   188.8
  FUEL CONSUMPTION,     L/100KM                  7.04

  HYDROCARBONS,         G/KM                      .07
  CARBON MONOXIDE,      G/KM                      .41
  OXIDES OF NITROGEN,   G/KM                      .36
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                                                FTP   VEHICLE EMISSIONS RESULTS
                                                        PROJECT 05-4874-001

  TEST NO.    2A2F34    RUN    5                    VEHICLE NO.2A                         TEST WEIGHT  1814. KG( 4000. LBS)
  VEHICLE MODEL    81 OLDS CUTLASS                  DATE     6/23/81                      ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
  ENGINE 5.7 L(350. CID) V-8                        BAG CART NO. 1 / CVS NO.  3           DIESEL     EM-469-F
  TRANSMISSION A3                                   DYNO NO.      2                       ODOMETER   4925. KM( 3060. MILES)

  BAROMETER 742.19 MM HG(29.22 IN HG)               DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
  RELATIVE HUMIDITY  59. PCT                        ABS. HUMIDITY 11.2 GM/KG
  BAG RESULTS                                                                             NOX HUMIDITY CORRECTION FACTOR  1.01
     BAG NUMBER                                         1                  2                  3                  4
     DESCRIPTION                                  COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

     BLOWER DIF P MM. H2O(IN. H2O)                703.6 (27.7)       706.1 (27.8)       703.6 (27.7)       708.7 (27.9)
     BLOWER INLET P MM. H2O(IN. H2O)              571.5 (22.5)       571.5 (22.5)       569.0 (22.4)       574.0 (22.6)
     BLOWER INLET TEMP. DEG. C(DEG. F)             35.0 ( 95.0)       32.2 ( 90.0)       35.6 ( 96.0)       32.8 ( 91.0)
     BLOWER REVOLUTIONS                              13858.             23819.             13853.             23811.
     TOT FLOW STD. CU. METRES(SCF)                135.5 ( 4785.)     234.3 ( 8271.)     135.4 ( 4780.)     233.8 ( 8256.)
     HC   SAMPLE METER/RANGE/PPM                  16.0/11/  16.      11.6/11/  12.      14.7/11/  15.      11.3/11/  11.
     HC   BCKGRD METER/RANGE/PPM                   6.7/ 1/   7.       5.7/ 1/   6.       5.7/ 1/   6.       5.0/ 1/   5.
     CO   SAMPLE METER/RANGE/PPM                  32.2/13/  30.      19.9/13/  18.      26.4/13/  24.      18.5/13/  17.
     CO   BCKGRD METER/RANGE/PPM                   2.0/13/   2.       1.9/13/   2.        .7/13/   1.        .8/13/   1.
     CO2  SAMPLE METER/RANGE/PCT                  43.2/ 3/  .74      28.2/ 3/  .46      38.7/ 3/  .65      28.0/ 3/  .46
     CO2  BCKGRD METER/RANGE/PCT                   2.9/ 3/  .04       2.5/ 3/  .04       3.2/ 3/  .05       3.0/ 3/  .05
     NOX  SAMPLE METER/RANGE/PPM                  13.9/ 2/  14.      10.9/ 2/  11.      12.8/ 2/  13.      10.7/ 2/  11.
     NOX  BCKGRD METER/RANGE/PPM                    .6/ 2/   1.        .5/ 2/   1.        .6/ 2/   1.        .4/ 2/   0.
     DILUTION FACTOR                                  18.06              28.72              20.38              28.95
     HC   CONCENTRATION PPM                           10.                 6.                 9.                 6.
     CO   CONCENTRATION PPM                           27.                16.                23.                16.
     CO2  CONCENTRATION PCT                           .70                .43                .61                .42
     NOX  CONCENTRATION PPM                          13.3               10.4               12.2               10.3
     HC   MASS GRAMS                                  .75                .83                .72                .87
     CO   MASS GRAMS                                 4.26               4.36               3.60               4.26
     CO2  MASS GRAMS                               1726.1             1830.6             1504.5             1700.2
     NOX  MASS GRAMS                                 3.51               4.74               3.21               4.68
     PARTICULATE MASS GRAMS                          2.34               1.41               1.40               1.28

     HC   GRAMS/KM                                    .13                .13                .13                .14
     CO   GRAMS/KM                                    .74                .71                .63                .69
     CO2  GRAMS/KM                                  299.6              297.3              262.3              289.3
     NOX  GRAMS/KM                                    .61                .77                .56                .76
     FUEL CONSUMPTION BY CB L/100KM                 11.18              11.10               9.79              10.00

     RUN TIME                SECONDS              505.               868.               505.               868.
     MEASURED DISTANCE       KM                   5.76               6.16               5.74               6.15
     SCF, DRY                                     .974               .977               .975               .977
          DFC, WET (DRY)                                    .950 ( .940)                          .960 ( .942)
          SCF, WET (DRY)                                   1.000 ( .976)                         1.000 ( .976)
          VOL (SCM)                                                369.8                                369.2
          SAM BLR (SCM)                                            78.25                                78.27
          KM  (MEASURED)                                           11.92                                11.89
          FUEL CONSUMPTION L/100KM                                 11.14                                10.31

COMPOSITE RESULTS
    TEST NUMBER              2A2F34                                                                 3-BAG         (4-BAG)
    BAROMETER      MM HG     742.2                               CARBON DIOXIDE        G/KM         288.2         ( 285.8)
    HUMIDITY       G/KG       11.2                               FUEL CONSUMPTION      L/100KM      10.76         ( 10.67)
    TEMPERATURE    DEG C      23.9                               HYDROCARBONS (THC)    G/KM           .13         (   .13)
                                                                 CARBON MONOXIDE       G/KM           .69         (   .69)
                                                                 OXIDES OF NITROGEN    G/KM           .68         (   .68)
                                                                 PARTICULATES          G/KM          .269         (  .264)
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                                       NYCC   VEHICLE EMISSIONS RESULTS
                                               PROJECT 05-4074-001

TEST NO.   2A2N35   RUN   5                   VEHICLE NO.2A                          TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS               DATE     6/23/81                       ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                    BAG CART NO.  1                        DIESEL     EM-469-F
TRANSMISSION A3                               DYNO NO.      2                        ODOMETER  4949. KM( 3075. MILES)
                                              CVS NO.   3

BAROMETER 742.70 MM HG(29.24 IN HG)           DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  56. PCT                    ABS. HUMIDITY 10.9 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                700.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)              571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)             33.3 ( 92.0)
  BLOWER REVOLUTIONS                              16441.
  TOT FLOW STD. CU. METRES(SCF)                161.4 ( 5699.)
  HC  SAMPLE METER/RANGE/PPM                   12.5/11/  12.
  HC  BCKGRD METER/RANGE/PPM                    5.0/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                   19.6/13/  18.
  CO  BCKGRD METER/RANGE/PPM                    1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                   24.4/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                    3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    9.6/ 2/  10.
  NOX BCKGRD METER/RANGE/PPM                     .4/ 2/   0.
  DILUTION FACTOR                                 33.49
  HC  CONCENTRATION PPM                              8.
  CO  CONCENTRATION PPM                             17.
  CO2 CONCENTRATION PCT                             .35
  NOX CONCENTRATION PPM                             9.2
  HC  MASS GRAMS                                     .71
  CO  MASS GRAMS                                    3.10
  CO2 MASS GRAMS                                  1037.6
  NOX MASS GRAMS                                    2.06
  PARTICULATE MASS GRAMS                             .75
  RUN TIME                  SECONDS               599.
       DFC, WET (DRY)                           .970 ( .953)
       SCF, WET (DRY)                          1.000 ( .978)
       VOL (SCM)                                 161.4
       SAM BLR (SCM)                             34.20
       KM  (MEASURED)                             1.95

  TEST NUMBER,                                   2A2N35
  BAROMETER,               MM HG                  742.7
  HUMIDITY,                G/KG                    10.9
  TEMPERATURE,             DEG C                   24.4
   CARBON DIOXIDE,          G/KM                  532.7
  FUEL CONSUMPTION,        L/100KM                19.92

  HYDROCARBONS,            G/KM                     .36
  CARBON MONOXIDE,         G/KM                    1.59
  OXIDES OF NITROGEN,      G/KM                    1.47
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   2A2N36   RUN  6                   VEHICLE NO.2A                         TEST WEIGHT  1814. KG( 4000. LBS)
VEHICLE MODEL   81 OLDS CUTLASS              DATE    6/23/81                       ACTUAL ROAD LOAD   8.6 KW( 11.5 HP)
ENGINE 5.7 L(350. CID) V-8                   BAG CART NO.  1                       DIESEL     EM-469-F
TRANSMISSION A3                              DYNO NO.      2                       ODOMETER  4950. KM( 3076. MILES)
                                             CVS NO.   3

BAROMETER 742.95 MM HG(29.25 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  55. PCT                   ABS. HUMIDITY 10.9 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                       NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           32.8 ( 91.0)
  BLOWER REVOLUTIONS                            16434.
  TOT FLOW STD. CU. METRES(SCF)              161.6 ( 5706.)
  HC  SAMPLE METER/RANGE/PPM                 11.6/11/  12.
  HC  BCKGRD METER/RANGE/PPM                  4.8/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 19.2/13/  17.
  CO  BCKGRD METER/RANGE/PPM                  .8/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 24.7/ 3/  .40
  CO2 BCKGRD METER/RANGE/PCT                  3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  9.3/ 2/   9.
  NOX BCKGRD METER/RANGE/PPM                  .4/ 2/   0.
  DILUTION FACTOR                                33.07
  HC  CONCENTRATION PPM                            7.
  CO  CONCENTRATION PPM                           16.
  CO2 CONCENTRATION PCT                           .35
  NOX CONCENTRATION PPM                           8.9
  HC  MASS GRAMS                                  .64
  CO  MASS GRAMS                                 3.07
  CO2 MASS GRAMS                               1045.5
  NOX MASS GRAMS                                 2.77
  PARTICULATE MASS GRAMS                          .70
  RUN TIME              SECONDS                  599.
      DFC, WET (DRY)                         .970 ( .952)
      SCF, WET (DRY)                        1.000 ( .978)
      VOL (SCM)                                 161.6
      SAM BLR (SCM)                             34.22
      KM  (MEASURED)                             1.85

  TEST NUMBER,                                 2A2N36
  BAROMETER,             MM HG                  743.0
  HUMIDITY,              G/KG                    10.9
  TEMPERATURE,           DEG C                   24.4
   CARBON DIOXIDE,        G/KM                  563.8
  FUEL CONSUMPTION,      L/100KM                21.07

  HYDROCARBONS,          G/KM                     .35
  CARBON MONOXIDE,       G/KM                    1.66
  OXIDES OF NITROGEN,    G/KM                    1.49
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APPENDIX E

TEST RESULTS,
FIAT TURBOCHARGED DIESEL
WITHOUT AFTERTREATMENT
FUELS EM-329-F AND EM-469-F

SUMMARY OF REGULATED EMISSIONS FROM FIAT TURBOCHARGED DIESEL RESEARCH VEHICLE, EM-329-F BASE FUEL, NO CATALYST

Test Code Test Type Date (1981) Run No.	3A1F01 3-b FTP 6/26 1	3A1F05 3-b FTP 6/29 2	3A1F09 3-b FTP 7/2 3	3A1F13 3-b FTP 7/6 4	3A1H02 HFET 6/26 1	3A1H06 HFET 6/29 2	3A1H10 HFET 7/2 3	3A1H14 HFET 7/6 4
HC, g/mi	0.40	0.37	0.40	0.37	0.11	0.10	0.11	0.10
CO, g/mi	1.37	1.32	1.29	1.40	0.47	0.47	0.43	0.43
NO_x g/mi	1.98	2.09	2.04	2.04	1.27	1.22	1.32	1.27
Part., g/mi	0.24	0.28	0.26	0.27	0.12	0.12	0.13	0.14
Fuel, mi/gal	23.0	22.2	23.2	22.5	36.6	37.1	36.5	36.0

Test Code Test Type Date (1981) Run No.	3A1N03 NYCC 6/26 1	3A1N07 NYCC 6/29 2	3A1N11 NYCC 7/2 3	3A1N15 NYCC 7/6 4	3A1S04 85 kph 6/26 1	3A1S08 85 kph 6/29 2	3A1S12 85 kph 7/2 3	3A1S16 85 kph 7/6 4
HC, g/mi	1.06	1.08	1.11	0.97	0.08	0.05	0.08	0.08
CO, g/mi	3.17	3.22	3.01	2.91	0.40	0.39	0.37	0.39
NO_x, g/mi	2.74	2.65	2.77	2.75	1.27	1.30	1.32	1.30
Part., g/mi	0.39	0.47	0.40	0.37	0.11	0.11	0.11	0.12
Fuel, mi/gal	14.5	14.7	14.3	14.6	37.2	38.0	37.3	36.5

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                                      FTP    VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.   3A1F01   RUN   1                VEHICLE NO.3A
VEHICLE MODEL       TC FIAT                DATE     6/26/81                       TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO. 1 / CVS NO.  3            ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                            DYNO NO.        2                      DIESEL     EM-329-F
                                                                                  ODOMETER  7657. KM( 4759. MILES)
BAROMETER 745.24 MM HG(29.34 IN HG)
RELATIVE HUMIDITY  59. PCT                 DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
BAG RESULTS                                ABS. HUMIDITY 11.1 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.01
  BAG NUMBER                                    1                  2                  3                  4
  DESCRIPTION                            COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)           698.5 (27.5)       706.1 (27.8)       703.6 (27.7)       698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)         566.4 (22.3)       571.5 (22.5)       571.5 (22.5)       571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        36.1 ( 97.0)       35.6 ( 96.0)       37.2 ( 99.0)       36.1 ( 97.0)
  BLOWER REVOLUTIONS                         13853.             23821.             13855.             23814.
  TOT FLOW STD. CU. METRES(SCF)           135.8 ( 4796.)     233.6 ( 8250.)     135.6 ( 4786.)     233.4 ( 8241.)
  HC  SAMPLE METER/RANGE/PPM              28.8/11/  29.      16.9/11/  17.      16.0/11/  16.      16.5/11/  17.
  HC  BCKGRD METER/RANGE/PPM               5.9/ 1/   6.       4.8/ 1/   5.       4.8/ 1/   5.       4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM              35.2/13/  33.      25.8/13/  24.      24.5/13/  22.      26.0/13/  24.
  CO  BCKGRD METER/RANGE/PPM                .9/13/   1.        .9/13/   1.        .8/13/   1.        .9/13/   1.
  CO2 SAMPLE METER/RANGE/PCT              38.4/ 3/  .65      27.3/ 3/  .45      34.1/ 3/  .57      27.1/ 3/  .44
  CO2 BCKGRD METER/RANGE/PCT               2.8/ 3/  .04       2.8/ 3/  .04       2.9/ 3/  .04       2.6/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM              25.5/ 2/  26.      18.3/ 2/  18.      23.5/ 2/  24.      17.9/ 2/  18.
  NOX BCKGRD METER/RANGE/PPM                .4/ 2/   0.        .4/ 2/   0.        .5/ 2/   1.        .5/ 2/   1.
  DILUTION FACTOR                              20.49              29.66              23.38              29.89
  HC  CONCENTRATION PPM                        23.                12.                11.                12.
  CO  CONCENTRATION PPM                        31.                22.                21.                22.
  CO2 CONCENTRATION PCT                        .61                .41                .53                .41
  NOX CONCENTRATION PPM                       25.1               17.9               23.0               17.4
  HC  MASS GRAMS                              1.82               1.65                .89               1.61
  CO  MASS GRAMS                              4.87               6.04               3.32               6.08
  CO2 MASS GRAMS                            1510.4             1738.7             1307.7             1734.4
  NOX MASS GRAMS                              6.61               8.11               6.05               7.87
  PARTICULATE MASS GRAMS                       .99                .95                .72                .92

  HC  GRAMS/KM                                 .32                .27                .16                .26
  CO  GRAMS/KM                                 .86                .99                .59               1.00
  CO2 GRAMS/KM                               266.4              286.5              230.9              285.2
  NOX GRAMS/KM                                1.17               1.34               1.07               1.29
  FUEL CONSUMPTION BY CB L/100KM             10.22              10.98               8.83              10.93

  RUN TIME                 SECONDS            505.               868.               505.               868.
  MEASURED DISTANCE        KM                 5.67               6.07               5.66               6.08
  SCF, DRY                                    .975               .977               .976               .977
       DFC, WET (DRY)                                .961 ( .943)                          .963 ( .945)
       SCF, WET (DRY)                               1.000 ( .976)                         1.000 ( .977)
       VOL (SCM)                                           369.5                                 368.9
       SAM BLR (SCM)                                       78.43                                 78.38
       KM  (MEASURED)                                      11.74                                 11.75
       FUEL CONSUMPTION L/100KM                            10.61                                  9.92
COMPOSITE RESULTS
   TEST NUMBER            3A1F01                                                               3-BAG      (4-BAG)
   BAROMETER     MM HG   745.2                     CARBON DIOXIDE         G/KM                 267.0     ( 266.6)
   HUMIDITY      G/KG     11.1                     FUEL CONSUMPTION       L/100KM              10.23     ( 10.22)
   TEMPERATURE   DEG C    23.9                     HYDROCARBONS (THC)     G/KM                   .25     (   .25)
                                                   CARBON MONOXIDE        G/KM                   .85     (   .86)
                                                   OXIDES OF NITROGEN     G/KM                  1.23     (  1.21)
                                                   PARTICULATES           G/KM                  .152     (  .151)
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                                        HFET   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   3A1H02   RUN   1                      VEHICLE NO.3A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT                       DATE     6/26/81               ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                       BAG CART NO.  1                DIESEL     EM-329-F
TRANSMISSION M5                                  DYNO NO.      2                ODOMETER  7680. KM( 4772. MILES)
                                                 CVS NO.   3

BAROMETER 744.47 MM HG(29.31 IN HG)              DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                       ABS. HUMIDITY 10.6 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   TEST CYCLE                                       HFET

   BLOWER DIF P MM. H2O(IN. H2O)                 698.5 (27.5)
   BLOWER INLET P MM. H2O(IN. H2O)               566.4 (22.3)
   BLOWER INLET TEMP. DEG. C(DEG. F)              37.8 (100.0)
   BLOWER REVOLUTIONS                               21009.
   TOT FLOW STD. CU. METRES(SCF)                 205.5 ( 7256.)
   HC  SAMPLE METER/RANGE/PPM                    13.7/11/  14.
   HC  BCKGRD METER/RANGE/PPM                     4.9/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM                    22.8/13/  21.
   CO  BCKGRD METER/RANGE/PPM                     1.0/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                    44.4/ 3/  .76
   CO2 BCKGRD METER/RANGE/PCT                     2.6/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM                    33.1/ 2/  33.
   NOX BCKGRD METER/RANGE/PPM                      .5/ 2/   1.
   DILUTION FACTOR                                  17.55
   HC  CONCENTRATION PPM                               9.
   CO  CONCENTRATION PPM                              19.
   CO2 CONCENTRATION PCT                              .72
   NOX CONCENTRATION PPM                             32.6
   HC  MASS GRAMS                                    1.07
   CO  MASS GRAMS                                    4.62
   CO2 MASS GRAMS                                  2719.1
   NOX MASS GRAMS                                   12.79
   PARTICULATE MASS GRAMS                            1.23
   RUN TIME             SECONDS                      765.
        DFC, WET (DRY)                           .943 ( .927)
        SCF, WET (DRY)                          1.000 ( .976)
        VOL (SCM)                                   205.5
        SAM BLR (SCM)                               43.83
        KM  (MEASURED)                              16.16

   TEST NUMBER,                                    3A1H02
   BARMETER,           MM HG                        744.5
   HUMIDITY,            G/KG                         10.6
   TEMPERATURE,        DEG C                         25.0
    CARBON DIOXIDE,     G/KM                        168.3
   FUEL CONSUMPTION,   L/100KM                       6.42

   HYDROCARBONS,        G/KM                          .07
   CARBON MONOXIDE,     G/KM                          .29
   OXIDES OF NITROGEN,  G/KM                          .79
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   3A1N03   RUN   1                  VEHICLE NO.3A                       TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                  DATE     6/26/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                     ODOMETER  7696. KM( 4782. MILES)
                                             CVS NO.   3

BAROMETER 744.22 MM HG(29.30 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  52. PCT                   ABS. HUMIDITY 10.2 GM/KG            NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)             698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          33.9 ( 93.0)
  BLOWER REVOLUTIONS                           16439.
  TOT FLOW STD. CU. METRES(SCF)             161.6 ( 5706.)
  HC  SAMPLE METER/RANGE/PPM                17.6/11/  18.
  HC  BCKGRD METER/RANGE/PPM                 4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                22.9/13/  21.
  CO  BCKGRD METER/RANGE/PPM                 1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                19.2/ 3/  .31
  CO2 BCKGRD METER/RANGE/PCT                 2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                10.9/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                               42.97
  HC  CONCENTRATION PPM                           13.
  CO  CONCENTRATION PPM                           20.
  CO2 CONCENTRATION PCT                           .26
  NOX CONCENTRATION PPM                          10.4
  HC  MASS GRAMS                                 1.23
  CO  MASS GRAMS                                 3.68
  CO2 MASS GRAMS                                783.3
  NOX MASS GRAMS                                 3.16
  PARTICULATE MASS GRAMS                          .45
  RUN TIME              SECONDS                  599.
      DFC, WET (DRY)                        .977 ( .960)
      SCF, WET (DRY)                       1.000 ( .980)
      VOL (SCM)                                 161.6
      SAM BLR (SCM)                             34.27
      KM  (MEASURED)                             1.86

  TEST NUMBER,                                3A1N03
  BAROMETER,            MM HG                  744.2
  HUMIDITY,             G/KG                    10.2
  TEMPERATURE,          DEG C                   24.4
   CARBON DIOXIDE,       G/KM                  420.2
  FUEL CONSUMPTION,     L/100KM                16.17

  HYDROCARBONS,         G/KM                     .66
  CARBON MONOXIDE,      G/KM                    1.97
  OXIDES OF NITROGEN,   G/KM                    1.70
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                                         85 KPH VEHICLE EMISSIONS RESULTS
                                               PROJECT 05-4874-001

TEST NO.   3A1S04   RUN   1                     VEHICLE NO.3A                         TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                     DATE    6/26/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                       DIESEL     EM-329-F
TRANSMISSION M5                                 DYNO NO.      2                       ODOMETER  7697. KM( 4783. MILES)
                                                CVS NO.    3

BAROMETER 744.22 MM HG(29.30 IN HG)             DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY  48. PCT                      ABS. HUMIDITY 10.6 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)                706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)              576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)             36.7 ( 98.0)
  BLOWER REVOLUTIONS                              32930.
  TOT FLOW STD. CU. METRES(SCF)                321.9 (11367.)
  HC   SAMPLE METER/RANGE/PPM                  11.3/11/  11.
  HC   BCKGRD METER/RANGE/PPM                   4.2/ 1/   4.
  CO   SAMPLE METER/RANGE/PPM                  22.6/13/  21.
  CO   BCKGRD METER/RANGE/PPM                   1.2/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                  48.5/ 3/  .84
  CO2  BCKGRD METER/RANGE/PCT                   2.7/ 3/  .04
  NOX  SAMPLE METER/RANGE/PPM                  37.2/ 2/  37.
  NOX  BCKGRD METER/RANGE/PPM                    .5/ 2/   1.
  DILUTION FACTOR                                  15.93
  HC   CONCENTRATION PPM                             7.
  CO   CONCENTRATION PPM                            19.
  CO2  CONCENTRATION PCT                            .80
  NOX  CONCENTRATION PPM                           36.7
  HC   MASS GRAMS                                   1.36
  CO   MASS GRAMS                                   7.11
  CO2  MASS GRAMS                                4712.5
  NOX  MASS GRAMS                                  22.56
  PARTICULATE MASS GRAMS                            1.99
  RUN TIME                 SECONDS                1200.
       DFC, WET (DRY)                          .937 ( .923)
       SCF, WET (DRY)                         1.000 ( .977)
       VOL (SCM)                                  321.9
       SAM BLR (SCM)                               68.53
       KM  (MEASURED)                              28.41

  TEST NUMBER,                                   3A1S04
  BAROMETER,            MM HG                     744.2
  HUMIDITY,             G/KG                       10.6
  TEMPERATURE,          DEG C                      26.7
   CARBON DIOXIDE,       G/KM                     165.9
  FUEL CONSUMPTION,     L/100KM                    6.33

  HYDROCARBONS,         G/KM                        .05
  CARBON MONOXIDE,      G/KM                        .25
  OXIDES OF NITROGEN,   G/KM                        .79
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                                          FTP    VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.    3A1F05    RUN   2
VEHICLE MODEL         TC FIAT                 VEHICLE NO.3A                      TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    DATE      6/29/81                  ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
TRANSMISSION M5                               BAG CART NO. 1 / CVS NO.  3        DIESEL      EM-329-F
                                              DYNO NO.       2                   ODOMETER  7736. KM( 4807. MILES)
BAROMETER 743.46 MM HG(29.27 IN HG)
RELATIVE HUMIDITY  53. PCT                    DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
BAG RESULTS                                   ABS. HUMIDITY 11.1 GM/KG
  BAG NUMBER                                                                     NOX HUMIDITY CORRECTION FACTOR  1.01
  DESCRIPTION                                      1                 2                  3                  4
                                             COLD TRANSIENT      STABILIZED       HOT TRANSIENT        STABILIZED
  BLOWER DIF P MM. H2O(IN. H2O)              703.6 (27.7)       698.5 (27.5)      701.0 (27.6)       698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)       566.4 (22.3)      571.5 (22.5)       571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           37.2 ( 99.0)       36.7 ( 98.0)      36.7 ( 98.0)       36.7 ( 98.0)
  BLOWER REVOLUTIONS                            13837.             23837.            13846.             23820.
  TOT FLOW STD. CU. METRES(SCF)              134.9 ( 4764.)     232.7 ( 8216.)    135.1 ( 4770.)     232.4 ( 8206.)
  HC  SAMPLE METER/RANGE/PPM                 18.7/11/  19.      16.7/11/  17.     16.8/11/  17.      16.5/11/  17.
  HC  BCKGRD METER/RANGE/PPM                  4.2/ 1/   4.       4.4/ 1/   4.      4.4/ 1/   4.       4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                 23.1/13/  21.      27.7/13/  25.     25.6/13/  23.      26.6/13/  24.
  CO  BCKGRD METER/RANGE/PPM                   .9/13/   1.       1.1/13/   1.      1.2/13/   1.       1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 44.6/ 3/  .76      27.7/ 3/  .45     34.3/ 3/  .57      27.2/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT                  2.8/ 3/  .04       2.9/ 3/  .04      3.0/ 3/  .05       3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 32.5/ 2/  33.      18.7/ 2/  19.     24.0/ 2/  24.      17.5/ 2/  18.
  NOX BCKGRD METER/RANGE/PPM                   .3/ 2/   0.        .4/ 2/   0.       .7/ 2/   1.        .8/ 2/   1.
  DILUTION FACTOR                               17.45              29.19             23.23              29.77
  HC  CONCENTRATION PPM                          15.                12.               13.                13.
  CO  CONCENTRATION PPM                          20.                24.               22.                23.
  CO2 CONCENTRATION PCT                          .72                .41               .53                .40
  NOX CONCENTRATION PPM                         32.2               18.3              23.3               16.7
  HC  MASS GRAMS                                1.15               1.67               .98               1.70
  CO  MASS GRAMS                                3.09               6.45              3.42               6.19
  CO2 MASS GRAMS                              1787.3             1755.4            1308.4             1709.3
  NOX MASS GRAMS                                8.43               8.27              6.11               7.54
  PARTICULATE MASS GRAMS                        1.30               1.06               .82                .93

  HC  GRAMS/KM                                   .20                .27               .17                .28
  CO  GRAMS/KM                                   .54               1.05               .60               1.01
  CO2 GRAMS/KM                                 313.0              286.7             229.4              279.7
  NOX GRAMS/KM                                  1.48               1.35              1.07               1.23
  FUEL CONSUMPTION BY CB L/100KM               11.95              10.99              8.77              10.73

  RUN TIME                 SECONDS              504.               868.              504.               868.
  MEASURED DISTANCE        KM                   5.71               6.12              5.70               6.11
  SCF, DRY                                      .976               .979              .978               .979
       DFC, WET (DRY)                                  .957 (  .941)                        .963 (  .946)
       SCF, WET (DRY)                                 1.000 (  .978)                       1.000 (  .978)
       VOL (SCM)                                             367.6                                367.5
       SAM BLR (SCM)                                          77.80                                77.75
       KM  (MEASURED)                                         11.83                                11.81
       FUEL CONSUMPTION L/100KM                               11.46                                 9.78
COMPOSITE RESULTS
  TEST NUMBER              3A1F05                                                        3-BAG        (4-BAG)
  BAROMETER      MM HG     743.5                   CARBON DIOXIDE         G/KM           276.4       ( 274.3)
  HUMIDITY       G/KG       11.1                   FUEL CONSUMPTION       L/100KM        10.58       ( 10.50)
  TEMPERATURE    DEG C      25.6                   HYDROCARBONS (THC)     G/KM             .23       (   .23)
                                                   CARBON MONOXIDE        G/KM             .82       (   .81)
                                                   OXIDES OF NITROGEN     G/KM            1.30       (  1.27)
                                                   PARTICULATES           G/KM            .176       (  .170)
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                                 HFET   VEHICLE EMISSIONS RESULTS
                                          PROJECT 05-4874-001
TEST NO.   3A1H06   RUN   2
VEHICLE MODEL       TC FIAT                 VEHICLE NO.3A                          TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                  DATE     6/29/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                             BAG CART NO.  1                        DIESEL     EM-329-F
                                            DYNO NO.      2                        ODOMETER  7759. KM( 4821. MILES)
                                            CVS NO.   3

BAROMETER 742.95 MM HG(29.25 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                  ABS. HUMIDITY 10.4 GM/KG               NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
   TEST CYCLE                                  HFET

   BLOWER DIF P MM. H2O(IN. H2O)            703.6 (27.7)
   BLOWER INLET P MM. H2O(IN. H2O)          571.5 (22.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)         37.2 ( 99.0)
   BLOWER REVOLUTIONS                          21028.
   TOT FLOW STD. CU. METRES(SCF)            204.8 ( 7232.)
   HC  SAMPLE METER/RANGE/PPM               12.3/11/  12.
   HC  BCKGRD METER/RANGE/PPM                4.0/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM               23.1/13/  21.
   CO  BCKGRD METER/RANGE/PPM                1.1/13/   1.
   CO2 SAMPLE METER/RANGE/PCT               44.6/ 3/  .76
   CO2 BCKGRD METER/RANGE/PCT                3.0/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM               32.5/ 2/  33.
   NOX BCKGRD METER/RANGE/PPM                 .6/ 2/   1.
   DILUTION FACTOR                             17.46
   HC  CONCENTRATION PPM                         9.
   CO  CONCENTRATION PPM                        20.
   CO2 CONCENTRATION PCT                         .72
   NOX CONCENTRATION PPM                       31.9
   HC  MASS GRAMS                               1.01
   CO  MASS GRAMS                               4.65
   CO2 MASS GRAMS                            2702.7
   NOX MASS GRAMS                              12.39
   PARTICULATE MASS GRAMS                       1.20
   RUN TIME                 SECONDS           766.
        DFC, WET (DRY)                      .943 ( .928)
        SCF, WET (DRY)                     1.000 ( .977)
        VOL (SCM)                             204.8
        SAM BLR (SCM)                          43.31
        KM  (MEASURED)                         16.27

   TEST NUMBER,                               3A1H06
   BAROMETER,              MM HG              743.0
   HUMIDITY,               G/KG                10.4
   TEMPERATURE,            DEG C               25.6
    CARBON DIOXIDE,         G/KM              166.1
   FUEL CONSUMPTION,       L/100KM              6.34

   HYDROCARBONS,           G/KM                 .06
   CARBON MONOXIDE,        G/KM                 .29
   OXIDES OF NITROGEN,     G/KM                 .76
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001
TEST NO.   3A1NO 7  RUN   2
VEHICLE MODEL       TC FIAT                VEHICLE NO.3A
ENGINE 2.0 L(122. CID) L-4                 DATE     6/29/81                  TEST WEIGHT  1361. KG( 3000. LBS)
TRANSMISSION M5                            BAG CART NO.  1                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
                                           DYNO NO.      2                   DIESEL     EM-329-F
                                           CVS NO.   3                       ODOMETER  7773. KM( 4830. MILES)

BAROMETER 742.95 MM HG(29.25 IN HG)        DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                 ABS. HUMIDITY 10.4 GM/KG
BAG RESULTS                                                                  NOX HUMIDITY CORRECTION FACTOR   .99
  TEST CYCLE                                  NYCC

  BLOWER DIF P MM. H2O(IN. H2O)            698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)          571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)         35.0 ( 95.0)
  BLOWER REVOLUTIONS                          16442.
  TOT FLOW STD. CU. METRES(SCF)            161.0 ( 5685.)
  HC  SAMPLE METER/RANGE/PPM               17.3/11/  17.
  HC  BCKGRD METER/RANGE/PPM                3.8/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM               23.4/13/  21.
  CO  BCKGRD METER/RANGE/PPM                1.0/13/   1.
  CO2 SAMPLE METER/RANGE/PCT               19.0/ 3/  .30
  CO2 BCKGRD METER/RANGE/PCT                2.7/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM               10.7/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                .6/ 2/   1.
  DILUTION FACTOR                             43.43
  HC  CONCENTRATION PPM                        14.
  CO  CONCENTRATION PPM                        20.
  CO2 CONCENTRATION PCT                        .26
  NOX CONCENTRATION PPM                       10.1
  HC  MASS GRAMS                               1.26
  CO  MASS GRAMS                               3.75
  CO2 MASS GRAMS                              779.2
  NOX MASS GRAMS                               3.08
  PARTICULATE MASS GRAMS                       .55
  RUN TIME            SECONDS                 599.
     DFC, WET (DRY)                        .977 ( .961)
     SCF, WET (DRY)                       1.000 ( .981)
     VOL (SCM)                                161.0
     SAM BLR (SCM)                            34.21
     KM  (MEASURED)                            1.87

  TEST NUMBER,                               3A1N06
  BAROMETER,           MM HG                  743.0
  HUMIDITY,            G/KG                    10.4
  TEMPERATURE,         DEG C                   25.6
   CARBON DIOXIDE,     G/KM                   415.7
  FUEL CONSUMPTION,    L/100KM                16.00

  HYDROCARBONS,        G/KM                     .67
  CARBON MONOXIDE,     G/KM                    2.00
  OXIDES OF NITROGEN,  G/KM                    1.65
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                                    85 KPH VEHICLE EMISSIONS RESULTS
                                         PROJECT 05-4874-001
TEST NO.   3A1S08   RUN   2
VEHICLE MODEL      TC FIAT                   VEHICLE NO.3A                   TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                   DATE     6/29/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                              BAG CART NO.  1                 DIESEL     EM-329-F
                                             DYNO NO.        2               ODOMETER  7776. KM( 4832. MILES)
                                             CVS NO.   3
BAROMETER 742.70 MM HG(29.24 IN HG)          DRY BULD TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  47. PCT                   ABS. HUMIDITY 10.2 GM/KG            NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
   TEST CYCLE                                     85 K

   BLOWER DIF P MM. H2O(IN. H2O)             703.6 (27.7)
   BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)          38.3 (101.0)
   BLOWER REVOLUTIONS                           32692.
   TOT FLOW STD. CU. METRES(SCF)             318.2 (11235.)
   HC  SAMPLE METER/RANGE/PPM                 8.8/11/    9.
   HC  BCKGRD METER/RANGE/PPM                 4.0/ 1/    4.
   CO  SAMPLE METER/RANGE/PPM                22.5/13/   21.
   CO  BCKGRD METER/RANGE/PPM                 1.3/13/    1.
   CO2 SAMPLE METER/RANGE/PCT                48.3/ 3/   .83
   CO2 BCKGRD METER/RANGE/PCT                 2.9/ 3/   .04
   NOX SAMPLE METER/RANGE/PPM                39.1/ 2/   39.
   NOX BCKGRD METER/RANGE/PPM                  .4/ 2/    0.
   DILUTION FACTOR                               16.00
   HC  CONCENTRATION PPM                           5.
   CO  CONCENTRATION PPM                          19.
   CO2 CONCENTRATION PCT                          .79
   NOX CONCENTRATION PPM                         38.7
   HC  MASS GRAMS                                  .93
   CO  MASS GRAMS                                 6.96
   CO2 MASS GRAMS                               4618.8
   NOX MASS GRAMS                                23.16
   PARTICULATE MASS GRAMS                         1.96
   RUN TIME                    SECONDS           1200.
        DFC, WET (DRY)                        .938 ( .923)
        SCF, WET (DRY)                       1.000 ( .977)
        VOL (SCM)                                318.2
        SAM BLR (SCM)                            67.94
        KM  (MEASURED)                           28.44

   TEST NUMBER,                                 3A1S08
   BAROMETER,             MM HG                  742.7
   HUMIDITY,              G/KG                    10.2
   TEMPERATURE,           DEG C                   26.1
    CARBON DIOXIDE,        G/KM                  162.4
   FUEL CONSUMPTION,      L/100KM                 6.19

   HYDROCARBONS,          G/KM                     .03
   CARBON MONOXIDE,       G/KM                     .24
   OXIDES OF NITROGEN,    G/KM                     .81
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                                          FTP    VEHICLE EMISSIONS RESULTS
                                                   PROJECT 05-4874-001

TEST NO.    3A1F09    RUN   3                VEHICLE NO.3A                         TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       YC FIAT                  DATE     7/ 2/81                      ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO. 1 / CVS NO.  3           DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.        2                     ODOMETER   7824. KM( 4861. MILES)

BAROMETER 740.66 MM HG(29.16 IN HG)          DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  66. PCT                   ABS. HUMIDITY 12.7 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.07
BAG RESULTS
  BAG NUMBER                                      1                 2                   3                   4
  DESCRIPTION                               COLD TRANSIENT      STABILIZED         HOT TRANSIENT         STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             701.0 (27.6)       701.0 (27.6)        701.0 (27.6)        698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)       571.5 (22.5)        571.5 (22.5)        571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          37.8 (100.0)       37.8 (100.0)        38.9 (102.0)        37.8 (100.0)
  BLOWER REVOLUTIONS                          13863.             23801.              13842.              23796.
  TOT FLOW STD. CU. METRES(SCF)             135.0 ( 4768.)     231.8 ( 8186.)      134.5 ( 4748.)      231.8 ( 8184.)
  HC  SAMPLE METER/RANGE/PPM                28.0/11/  28.      16.8/11/  17.       17.4/11/  17.       17.0/11/  17.
  HC  BCKGRD METER/RANGE/PPM                 5.4/ 1/   5.       4.4/ 1/   4.        4.3/ 1/   4.        4.3/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                36.6/13/  34.      26.6/13/  24.       25.0/13/  23.       25.5/13/  23.
  CO  BCKGRD METER/RANGE/PPM                 3.1/13/   3.       2.9/13/   3.        3.2/13/   3.        2.8/13/   3.
  CO2 SAMPLE METER/RANGE/PCT                38.5/ 3/  .65      27.7/ 3/  .45       34.6/ 3/  .58       27.5/ 3/  .45
  CO2 BCKGRD METER/RANGE/PCT                 2.8/ 3/  .04       2.6/ 3/  .04        3.2/ 3/  .05        3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                26.0/ 2/  26.      18.3/ 2/  18.       23.5/ 2/  24.       18.0/ 2/  18.
  NOX BCKGRD METER/RANGE/PPM                  .3/ 2/   0.        .3/ 2/   0.         .5/ 2/   1.         .6/ 2/   1.
  DILUTION FACTOR                              20.43              29.20               23.01               29.43
  HC  CONCENTRATION PPM                        23.                13.                 13.                 13.
  CO  CONCENTRATION PPM                        30.                21.                 19.                 20.
  CO2 CONCENTRATION PCT                         .61                .42                 .53                 .41
  NOX CONCENTRATION PPM                        25.7               18.0                23.0                17.4
  HC  MASS GRAMS                                1.78               1.68                1.03                1.71
  CO  MASS GRAMS                                4.74               5.71                3.04                5.46
  CO2 MASS GRAMS                             1506.0             1767.8              1308.7              1727.3
  NOX MASS GRAMS                                7.10               8.53                6.33                8.25
  PARTICULATE MASS GRAMS                        1.27                .95                 .76                 .86

  HC  GRAMS/KM                                  .31                .27                 .18                 .28
  CO  GRAMS/KM                                  .83                .93                 .53                 .88
  CO2 GRAMS/KM                                262.5              286.8               226.7               278.9
  NOX GRAMS/KM                                 1.24               1.38                1.10                1.33
  FUEL CONSUMPTION BY CB L/100KM              10.07              10.99                8.67               10.69

  RUN TIME              SECONDS               505.               867.                505.                868.
  MEASURED DISTANCE     KM                    5.74               6.16                5.77                6.19
  SCF, DRY                                    .973               .974                .973                .974
      DFC, WET (DRY)                                  .960 ( .940)                             .963 ( .942)
      SCF, WET (DRY)                                 1.000 ( .974)                            1.000 ( .974)
      VOL (SCM)                                              366.9                                   366.3
      SAM BLR (SCM)                                           77.94                                   77.82
      KM  (MEASURED)                                          11.90                                   11.97
      FUEL CONSUMPTION L/100KM                                10.54                                    9.71

COMPOSITE RESULTS
  TEST NUMBER             3A1F09                                                             3-BAG      (4-BAG)
  BAROMETER      MM HG    740.7                  CARBON DIOXIDE          G/KM                265.2      ( 262.9)
  HUMIDITY       G/KG      12.7                  FUEL CONSUMPTION        L/100KM             10.16      ( 10.07)
  TEMPERATURE    DEG C     23.9                  HYDROCARBONS (THC)      G/KM                  .25      (   .26)
                                                 CARBON MONOXIDE         G/KM                  .80      (   .78)
                                                 OXIDES OF NITROGEN      G/KM                 1.27      (  1.26)
                                                 PARTICULATES            G/KM                  .161     (  .157)
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                                       HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001
TEST NO.   3A1H10   RUN   3
VEHICLE MODEL       TC FIAT                   VEHICLE NO.3A                    TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    DATE    7/ 2/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                               BAG CART NO.  1                  DIESEL     EM-329-F
                                              DYNO NO.      2                  ODOMETER   7846. KM( 4875. MILES)
                                              CVS NO.   3
BAROMETER 740.16 MM HG(29.14 IN HG)
RELATIVE HUMIDITY  57. PCT                    DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
BAG RESULTS                                   ABS. HUMIDITY 11.9 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.04
  TEST CYCLE
                                                HFET
  BLOWER DIF P MM. H2O(IN. H2O)               701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)             571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             21007.
  TOT FLOW STD. CU. METRES(SCF)               204.2 ( 7210.)
  HC   SAMPLE METER/RANGE/PPM                 13.7/11/  14.
  HC   BCKGRD METER/RANGE/PPM                  4.2/ 1/   4.
  CO   SAMPLE METER/RANGE/PPM                 24.6/13/  22.
  CO   BCKGRD METER/RANGE/PPM                  3.5/13/   3.
  CO2 SAMPLE METER/RANGE/PCT                  46.0/ 3/  .79
  CO2 BCKGRD METER/RANGE/PCT                   3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  33.4/ 2/  33.
  NOX BCKGRD METER/RANGE/PPM                    .4/ 2/   0.
  DILUTION FACTOR                                16.87
  HC   CONCENTRATION PPM                          10.
  CO   CONCENTRATION PPM                          19.
  CO2 CONCENTRATION PCT                           .74
  NOX CONCENTRATION PPM                          33.0
  HC   MASS GRAMS                                 1.14
  CO   MASS GRAMS                                 4.47
  CO2 MASS GRAMS                               2772.0
  NOX MASS GRAMS                                 13.44
  PARTICULATE MASS GRAMS                          1.30
  RUN TIME                   SECONDS             766.
       DFC, WET (DRY)                         .941 ( .924)
       SCF, WET (DRY)                        1.000 ( .974)
       VOL (SCM)                                 204.2
       SAM BLR (SCM)                             43.24
       KM  (MEASURED)                            16.41

  TEST NUMBER,                                 3A1H10
  BAROMETER,             MM HG                  740.2
  HUMIDITY,              G/KG                    11.9
  TEMPERATURE,           DEG C                   25.6
   CARBON DIOXIDE,        G/KM                  168.9
  FUEL CONSUMPTION,      L/100KM                 6.44

  HYDROCARBONS,          G/KM                     .07
  CARBON MONOXIDE,       G/KM                     .27
  OXIDES OF NITROGEN,    G/KM                     .82
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                                   NYCC   VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.    3A1N11    RUN   3                VEHICLE NO.3A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT                   DATE     7/ 2/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                        DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.       2                       ODOMETER  7861. KM( 4884. MILES)
                                             CVS NO.    3

BAROMETER 740.16 MM HG(29.14 IN HG)          DRY BULB TEMP. 26.1 DEG C(79.0 DEG F)
RELATIVE HUMIDITY  50. PCT                   ABS. HUMIDITY 11.0 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
   TEST CYCLE                                    NYCC

   BLOWER DIF P MM. H2O(IN. H2O)              706.1 (27.8)
   BLOWER INLET P MM. H2O(IN. H2O)            576.6 (22.7)
   BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)
   BLOWER REVOLUTIONS                            16425.
   TOT FLOW STD. CU. METRES(SCF)              160.3 ( 5659.)
   HC  SAMPLE METER/RANGE/PPM                 18.1/11/  18.
   HC  BCKGRD METER/RANGE/PPM                  4.3/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM                 24.8/13/  23.
   CO  BCKGRD METER/RANGE/PPM                  4.0/13/   4.
   CO2 SAMPLE METER/RANGE/PCT                 20.2/ 3/  .33
   CO2 BCKGRD METER/RANGE/PCT                  3.6/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM                 10.8/ 2/  11.
   NOX BCKGRD METER/RANGE/PPM                   .4/ 2/   0.
   DILUTION FACTOR                                40.72
   HC  CONCENTRATION PPM                           14.
   CO  CONCENTRATION PPM                           19.
   CO2 CONCENTRATION PCT                           .27
   NOX CONCENTRATION PPM                          10.4
   HC  MASS GRAMS                                 1.28
   CO  MASS GRAMS                                 3.49
   CO2 MASS GRAMS                                795.7
   NOX MASS GRAMS                                 3.22
   PARTICULATE MASS GRAMS                          .46
   RUN TIME                  SECONDS              599.
        DFC, WET (DRY)                         .975 ( .960)
        SCF, WET (DRY)                        1.000 ( .981)
        VOL (SCM)                                160.3
        SAM BLR (SCM)                            33.89
        KM  (MEASURED)                            1.86

   TEST NUMBER,                                 3A1N11
   BAROMETER,              MM HG                 740.2
   HUMIDITY,               G/KG                   11.0
   TEMPERATURE,            DEG C                  26.1
    CARBON DIOXIDE,         G/KM                 426.7
   FUEL CONSUMPTION,       L/100KM               16.41

   HYDROCARBONS,           G/KM                    .69
   CARBON MONOXIDE,        G/KM                   1.87
   OXIDES OF NITROGEN,     G/KM                   1.72
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                                        85 KPH VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   3A1S12   RUN   3                  VEHICLE NO.3A
VEHICLE MODEL       TC FIAT                  DATE     7/ 2/81                TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                              DYNO NO.      2                 DIESEL     EM-329-F
                                             CVS NO.   3                     ODOMETER  7863. KM( 4886. MILES)

BAROMETER 740.16 MM HG(29.14 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT                   ABS. HUMIDITY 11.2 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                    85 K

  BLOWER DIF P MM. H2O(IN. H2O)              701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           37.8 (100.0)
  BLOWER REVOLUTIONS                            32899.
  TOT FLOW STD. CU. METRES(SCF)              319.7 (11290.)
  HC  SAMPLE METER/RANGE/PPM                 11.4/11/  11.
  HC  BCKGRD METER/RANGE/PPM                  4.0/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                 23.7/13/  22.
  CO  BCKGRD METER/RANGE/PPM                  3.6/13/   3.
  CO2 SAMPLE METER/RANGE/PCT                 49.3/ 3/  .85
  CO2 BCKGRD METER/RANGE/PCT                  3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 38.1/ 2/  38.
  NOX BCKGRD METER/RANGE/PPM                   .5/ 2/   1.
  DILUTION FACTOR                               15.64
  HC  CONCENTRATION PPM                            8.
  CO  CONCENTRATION PPM                           18.
  CO2 CONCENTRATION PCT                           .80
  NOX CONCENTRATION PPM                          37.6
  HC  MASS GRAMS                                 1.41
  CO  MASS GRAMS                                 6.68
  CO2 MASS GRAMS                               4703.4
  NOX MASS GRAMS                                23.39
  PARTICULATE MASS GRAMS                         1.95
  RUN TIME               SECONDS               1200.
       DFC, WET (DRY)                         .936 ( .920)
       SCF, WET (DRY)                        1.000 ( .975)
       VOL (SCM)                               319.7
       SAM BLR (SCM)                           67.90
       KM  (MEASURED)                          28.42

  TEST NUMBER,                                3A1S12
  BAROMETER,            MM HG                  740.2
  HUMIDITY,             G/KG                    11.2
  TEMPERATURE,          DEG C                   25.6
   CARBON DIOXIDE,       G/KM                  165.5
  FUEL CONSUMPTION,     L/100KM                 6.31

  HYDROCARBONS,         G/KM                     .05
  CARBON MONOXIDE,      G/KM                     .23
  OXIDES OF NITROGEN,   G/KM                     .82
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                                        FTP    VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.    3A1F13    RUN    4                VEHICLE NO.3A                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                   DATE     7/ 6/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO. 1 / CVS NO.  3        DIESEL     EM-329-F
TRANSMISSION M5                               DYNO NO.      2                    ODOMETER  7902. KM( 4910. MILES)

BAROMETER 739.14 MM HG(29.10 IN HG)           DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  59. PCT                    ABS. HUMIDITY 11.7 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  BAG NUMBER                                      1                  2                  3                   4
  DESCRIPTION                               COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             693.4 (27.3)       696.0 (27.4)      693.4 (27.3)       696.0 (27.4)
  BLOWER INLET P MM. H2O(IN. H2O)           566.4 (22.3)       569.0 (22.4)      566.4 (22.3)       569.0 (22.4)
  BLOWER INLET TEMP. DEG. C(DEG. F)          37.5 ( 99.5)       35.6 ( 96.0)      37.2 ( 99.0)       36.7 ( 98.0)
  BLOWER REVOLUTIONS                          13851.              23808.            13862.             23788.
  TOT FLOW STD. CU. METRES(SCF)             134.7 ( 4756.)     232.1 ( 8194.)    134.8 ( 4760.)     231.5 ( 8174.)
  HC  SAMPLE METER/RANGE/PPM                28.6/11/  29.      16.4/11/  16.     17.0/11/  17.      16.9/11/  17.
  HC  BCKGRD METER/RANGE/PPM                 6.5/ 1/   7.       5.5/ 1/   6.      5.5/ 1/   6.       4.9/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                43.0/13/  40.      29.0/13/  27.     26.2/13/  24.      26.2/13/  24.
  CO  BCKGRD METER/RANGE/PPM                 4.0/13/   4.       3.7/13/   3.      3.0/13/   3.       2.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                40.7/ 3/  .69      28.7/ 3/  .47     34.9/ 3/  .58      28.0/ 3/  .46
  CO2 BCKGRD METER/RANGE/PCT                 3.3/ 3/  .05       3.0/ 3/  .05      3.1/ 3/  .05       3.6/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                27.7/ 2/  28.      18.9/ 2/  19.     24.0/ 2/  24.      17.8/ 2/  18.
  NOX BCKGRD METER/RANGE/PPM                  .6/ 2/   1.        .4/ 2/   0.       .5/ 2/   1.        .4/ 2/   0.
  DILUTION FACTOR                               19.21              28.10             22.79              28.87
  HC  CONCENTRATION PPM                         22.                11.               12.                12.
  CO  CONCENTRATION PPM                         36.                23.               21.                21.
  CO2 CONCENTRATION PCT                          .64                .43               .54                .41
  NOX CONCENTRATION PPM                         27.1               18.5              23.5               17.4
  HC  MASS GRAMS                                 1.75               1.49               .91               1.62
  CO  MASS GRAMS                                 5.57               6.14              3.25               5.66
  CO2 MASS GRAMS                              1585.3             1819.7            1329.3             1724.5
  NOX MASS GRAMS                                 7.22               8.49              6.27               7.97
  PARTICULATE MASS GRAMS                         1.23               1.02               .76                .96

  HC  GRAMS/KM                                    .30                .24               .16                .26
  CO  GRAMS/KM                                    .97                .99               .57                .92
  CO2 GRAMS/KM                                 275.3              293.1             232.6              281.6
  NOX GRAMS/KM                                   1.25               1.37              1.10               1.30
  FUEL CONSUMPTION BY CB L/100KM                10.56              11.23              8.89              10.79

  RUN TIME               SECONDS               505.               868.              505.               867.
  MEASURED DISTANCE      KM                      5.76               6.21              5.72               6.12
  SCF, DRY                                        .974               .977              .975               .977
      DFC, WET (DRY)                                    .958 ( .940)                         .962 ( .944)
      SCF, WET (DRY)                                   1.000 ( .976)                        1.000 ( .976)
      VOL (SCM)                                                366.8                                366.3
      SAM BLR (SCM)                                             77.54                                77.48
      KM  (MEASURED)                                            11.97                                11.84
      FUEL CONSUMPTION L/100KM                                  10.91                                 9.87

COMPOSITE RESULTS
  TEST NUMBER           3A1F13                                                       3-BAG       (4-BAG)
  BAROMETER     MM HG   739.1                   CARBON DIOXIDE        G/KM           272.9      ( 269.4)
  HUMIDITY      G/KG     11.7                   FUEL CONSUMPTION      L/100KM        10.45      ( 10.32)
  TEMPERATURE   DEG C    24.4                   HYDROCARBONS (THC)    G/KM             .23      (   .24)
                                                CARBON MONOXIDE       G/KM             .87      (   .85)
                                                OXIDES OF NITROGEN    G/KM            1.27      (  1.25)
                                                PARTICULATES          G/KM            .166      (  .164)
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                                         HFET   VEHICLE EMISSIONS RESULTS
                                                   PROJECT 05-4874-001

TEST NO.   3A1H14    RUN   4
VEHICLE MODEL        TC FIAT                   VEHICLE NO.3A                         TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                     DATE     7/ 6/81                      ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                BAG CART NO.  1                       DIESEL     EM-329-F
                                               DYNO NO.      2                       ODOMETER  7926. KM( 4925. MILES)
                                               CVS NO.   3

BAROMETER 738.89 MM HG(29.09 IN HG)            DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT                     ABS. HUMIDITY 11.2 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                        HFET

  BLOWER DIF P MM. H2O(IN. H2O)                698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)              563.9 (22.2)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.8 (100.0)
  BLOWER REVOLUTIONS                             21014.
  TOT FLOW STD. CU. METRES(SCF)                204.3 ( 7214.)
  HC  SAMPLE METER/RANGE/PPM                   13.1/11/  13.
  HC  BCKGRD METER/RANGE/PPM                    4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                   23.1/13/  21.
  CO  BCKGRD METER/RANGE/PPM                    2.1/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                   46.2/ 3/  .79
  CO2 BCKGRD METER/RANGE/PCT                    3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                   33.2/ 2/  33.
  NOX BCKGRD METER/RANGE/PPM                    1.0/ 2/   1.
  DILUTION FACTOR                                 16.80
  HC  CONCENTRATION PPM                              9.
  CO  CONCENTRATION PPM                             19.
  CO2 CONCENTRATION PCT                             .74
  NOX CONCENTRATION PPM                            32.3
  HC  MASS GRAMS                                   1.02
  CO  MASS GRAMS                                   4.44
  CO2 MASS GRAMS                                 2782.4
  NOX MASS GRAMS                                  12.82
  PARTICULATE MASS GRAMS                           1.45
  RUN TIME                 SECONDS                 766.
       DFC, WET (DRY)                          .940 ( .924)
       SCF, WET (DRY)                         1.000 ( .975)
       VOL (SCM)                                  204.3
       SAM BLR (SCM)                              43.30
       KM  (MEASURED)                             16.25

  TEST NUMBER,                                   3A1H14
  BAROMETER,               MM HG                  738.9
  HUMIDITY,                G/KG                    11.2
  TEMPERATURE,             DEG C                   25.6
   CARBON DIOXIDE,          G/KM                  171.2
  FUEL CONSUMPTION,        L/100KM                 6.53

  HYDROCARBONS,            G/KM                     .06
  CARBON MONOXIDE,         G/KM                     .27
  OXIDES OF NITROGEN,      G/KM                     .79
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.   3A1N15   RUN   4                  VEHICLE NO.3A                            TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                  DATE    7/ 6/81                          ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                          DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                          ODOMETER  7942. KM( 4935. MILES)
                                             CVS NO.   3

BAROMETER 739.14 MM HG(29.10 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  56. PCT                   ABS. HUMIDITY 11.0 GM/KG                 NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  TEST CYCLE                                     NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           34.4 ( 94.0)
  BLOWER REVOLUTIONS                            16420.
  TOT FLOW STD. CU. METRES(SCF)              160.4 ( 5663.)
  HC  SAMPLE METER/RANGE/PPM                 17.1/11/  17.
  HC  BCKGRD METER/RANGE/PPM                  4.6/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                 22.6/13/  21.
  CO  BCKGRD METER/RANGE/PPM                  1.5/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 20.4/ 3/  .33
  CO2 BCKGRD METER/RANGE/PCT                  3.5/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 11.2/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                   .5/ 2/   1.
  DILUTION FACTOR                                40.34
  HC  CONCENTRATION PPM                           13.
  CO  CONCENTRATION PPM                           19.
  CO2 CONCENTRATION PCT                           .28
  NOX CONCENTRATION PPM                          10.7
  HC  MASS GRAMS                                  1.16
  CO  MASS GRAMS                                  3.51
  CO2 MASS GRAMS                                810.8
  NOX MASS GRAMS                                  3.31
  PARTICULATE MASS GRAMS                           .45
  RUN TIME              SECONDS                599.
       DFC, WET (DRY)                        .975 ( .958)
       SCF, WET (DRY)                       1.000 ( .979)
       VOL (SCM)                               160.4
       SAM BLR (SCM)                           33.86
       KM  (MEASURED)                           1.94

  TEST NUMBER,                                 3A1N15
  BARMETER,            MM HG                  739.1
  HUMIDITY,            G/KG                    11.0
  TEMPERATURE,         DEG C                   24.4
   CARBON DIOXIDE,      G/KM                  418.4
  FUEL CONSUMPTION,    L/100KM                16.08

  HYDROCARBONS,        G/KM                     .60
  CARBON MONOXIDE,     G/KM                    1.81
  OXIDES OF NITROGEN,  G/KM                    1.71
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                               85 KPH VEHICLE EMISSIONS RESULTS
                                   PROJECT 05-4874-001

TEST NO.   3A1S16    RUN   4                    VEHICLE NO.3A                       TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        TC FIAT                    DATE    7/ 6/81                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                     DIESEL     EM-329-F
TRANSMISSION M5                                 DYNO NO.      2                     ODOMETER  7944. KM( 4936. MILES)
                                                CVS NO.   3

BAROMETER 739.39 MM HG(29.11 IN HG)             DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  53. PCT                      ABS. HUMIDITY 11.2 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                      85 K

  BLOWER DIF P MM. H2O(IN. H2O)                 698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)               566.4 (22.3)
  BLOWER INLET TEMP. DEG. C(DEG. F)              42.8 (109.0)
  BLOWER REVOLUTIONS                               32916.
  TOT FLOW STD. CU. METRES(SCF)                 316.3 (11168.)
  HC  SAMPLE METER/RANGE/PPM                    12.7/11/  13.
  HC  BCKGRD METER/RANGE/PPM                     4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                    22.7/13/  21.
  CO  BCKGRD METER/RANGE/PPM                     1.8/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                    50.4/ 3/  .87
  CO2 BCKGRD METER/RANGE/PCT                     3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    37.8/ 2/  38.
  NOX BCKGRD METER/RANGE/PPM                      .4/ 2/   0.
  DILUTION FACTOR                                  15.26
  HC  CONCENTRATION PPM                              8.
  CO  CONCENTRATION PPM                             19.
  CO2 CONCENTRATION PCT                             .83
  NOX CONCENTRATION PPM                            37.4
  HC  MASS GRAMS                                    1.51
  CO  MASS GRAMS                                    6.82
  CO2 MASS GRAMS                                 4792.5
  NOX MASS GRAMS                                   23.02
  PARTICULATE MASS GRAMS                            2.19
  RUN TIME             SECONDS                   1200.
       DFC, WET (DRY)                            .934 ( .918)
       SCF, WET (DRY)                           1.000 ( .975)
       VOL (SCM)                                 316.3
       SAM BLR (SCM)                              67.75
       KM  (MEASURED)                             28.39

  TEST NUMBER,                                   3A1S16
  BARONETER,           MM HG                      739.4
  HUMIDITY,            G/KG                        11.2
  TEMPERATURE,         DEG C                       25.6
   CARBON DIOXIDE,      G/KM                      168.8
  FUEL CONSUMPTION,    L/100KM                     6.44

  HYDROCARBONS,        G/KM                         .05
  CARBON MONOXIDE,     G/KM                         .24
  OXIDES OF NITROGEN,  G/KM                         .81
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SUMMARY OF REGULATED EMISSIONS FROM FIAT TURBOCHARGED DIESEL RESEARCH VEHICLE, EM-469-F FUEL, NO CATALYST

Test Code Test Type Date (1981) Run No.	3A2F20 3-b FTP 7/9 1	3A2F24 3-b FTP 7/10 2	3A2F28 3-b FTP 7/13 3	3A2H21 HFET 7/9 1	3A2H25 HFET 7/10 2	3A2H29 HFET 7/13 3
HC, g/mi	0.51	0.50	0.42	0.11	0.13	0.11
CO, g/mi	1.58	1.59	1.58	0.50	0.51	0.48
NO_x, g/mi	2.00	2.06	2.01	1.27	1.27	1.30
Part., g/mi	0.30	0.35	--a	0.13	0.13	--a
Fuel, mi/gal	23.3	22.7	23.1	37.5	35.9	37.5

Test Code Test Type Date (1981) Run No.	3A2N22 NYCC 7/9 1	3A2N26 NYCC 7/10 2	3A2N30 NYCC 7/13 3	3A2S23 85 kph 7/9 1	3A2S27 85 kph 7/10 2	3A2S31 85 kph 7/13 3
HC, g/mi	1.29	1.26	1.24	0.10	0.10	0.10
CO, g/mi	3.64	3.51	3.27	0.40	0.47	0.42
NO_x, g/mi	2.82	2.70	2.70	1.21	1.16	1.29
Part, g/mi	0.49	0.55	--a	0.11	0.11	--a
Fuel, mi/gal	14.4	14.9	14.8	38.0	37.0	37.6

[a] particulate not sampled

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                                                FTP    VEHICLE EMISSIONS RESULTS
                                                        PROJECT 05-4874-001

TEST NO.   3A2F20   RUN   1                     VEHICLE NO.3A                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL     TC FIAT                       DATE    7/ 9/81                        ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO. 1 / CVS NO.  3            DIESEL    EM-469-F
TRANSMISSION M5                                 DYNO NO.      2                        ODOMETER  8048. KM( 5001. MILES)

BAROMETER 746.51 MM HG(29.39 IN HG)             DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  55. PCT                      ABS. HUMIDITY 10.8 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  BAG NUMBER                                        1                 2                    3                 4
  DESCRIPTION                                 COLD TRANSIENT      STABILIZED          HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)               698.5 (27.5)      701.0 (27.6)        701.0 (27.6)        698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)             571.5 (22.5)      571.5 (22.5)        571.5 (22.5)        571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.2 ( 99.0)      37.8 (100.0)        37.2 ( 99.0)        37.2 ( 99.0)
  BLOWER REVOLUTIONS                            13845.            23810.              13846.              23806.
  TOT FLOW STD. CU. METRES(SCF)               136.3 ( 4812.)    234.2 ( 8270.)      136.3 ( 4812.)      234.3 ( 8273.)
  HC   SAMPLE METER/RANGE/PPM                 36.4/11/  36.     21.6/11/  22.       19.3/11/  19.       19.2/11/  19.
  HC   BCKGRD METER/RANGE/PPM                  6.6/ 1/   7.      5.8/ 1/   6.        4.9/ 1/   5.        4.9/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                 47.9/13/  45.     33.5/13/  31.       30.4/13/  28.       30.0/13/  28.
  CO   BCKGRD METER/RANGE/PPM                  5.9/13/   5.      5.3/13/   5.        4.0/13/   4.        3.6/13/   3.
  CO2  SAMPLE METER/RANGE/PCT                 40.4/ 3/  .69     27.9/ 3/  .46       35.1/ 3/  .59       27.5/ 3/  .45
  CO2  BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05      2.9/ 3/  .04        3.6/ 3/  .06        3.5/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                 28.0/ 2/  28.     18.8/ 2/  19.       23.5/ 2/  24.       18.7/ 2/  19.
  NOX  BCKGRD METER/RANGE/PPM                   .2/ 2/   0.       .4/ 2/   0.         .2/ 2/   0.         .4/ 2/   0.
  DILUTION FACTOR                                 19.33             28.91               22.63               29.39
  HC   CONCENTRATION PPM                          30.               16.                 15.                 14.
  CO   CONCENTRATION PPM                          39.               26.                 24.                 24.
  CO2  CONCENTRATION PCT                          .64               .42                 .53                 .40
  NOX  CONCENTRATION PPM                         27.8              18.4                23.3                18.3
  HC   MASS GRAMS                                 2.37              2.15                1.15                1.95
  CO   MASS GRAMS                                 6.14              6.97                3.77                6.48
  CO2  MASS GRAMS                              1593.7            1782.2              1334.2              1714.0
  NOX  MASS GRAMS                                 7.28              8.28                6.10                8.24
  PARTICULATE MASS GRAMS                          1.57              1.04                 .87                 .96

  HC   GRAMS/KM                                   .41               .35                 .20                 .31
  CO   GRAMS/KM                                  1.07              1.12                 .66                1.04
  CO2  GRAMS/KM                                 277.1             286.7               232.1               276.3
  NOX  GRAMS/KM                                  1.27              1.33                1.06                1.33
  FUEL CONSUMPTION BY CB L/100KM                10.40             10.75                8.68               10.36

  RUN TIME              SECONDS                 505.              868.                505.                868.
  MEASURED DISTANCE     KM                       5.75              6.22                5.75                6.20
  SCF, DRY                                       .976              .978                .977                .978
       DFC, WET (DRY)                                  .959 ( .942)                           .962 ( .945)
       SCF, WET (DRY)                                 1.000 ( .977)                          1.000 ( .977)
       VOL (SCM)                                             370.5                                  370.6
       SAM BLR (SCM)                                          79.05                                  78.96
       KM  (MEASURED)                                         11.97                                  11.95
       FUEL CONSUMPTION L/100KM                               10.58                                   9.55

COMPOSITE RESULTS                                                                                  3-BAG       (4-BAG)
  TEST NUMBER           3A2F20                                    CARBON DIOXIDE          G/KM     269.8      ( 266.7)
  BAROMETER    MM HG    746.5                                     FUEL CONSUMPTION        L/100KM  10.11      (  9.99)
  HUMIDITY     G/KG      10.8                                     HYDROCARBONS (THC)      G/KM       .32      (   .31)
  TEMPERATURE  DEG C     24.4                                     CARBON MONOXIDE         G/KM       .98      (   .96)
                                                                  OXIDES OF NITROGEN      G/KM      1.24      (  1.24)
                                                                  PARTICULATES            G/KM      .185      (  .181)
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                                       HFET   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   3A2H21   RUN   1               VEHICLE NO.3A                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT               DATE     7/ 9/81               ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                BAG CART NO.  1                DIESEL     EM469-F
TRANSMISSION M5                           DYNO NO.      2                ODOMETER  8071. KM( 5015. MILES)
                                          CVS NO.   3

BAROMETER 746.25 MM HG(29.38 IN HG)       DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                ABS. HUMIDITY 10.6 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                HFET

  BLOWER DIF P MM. H2O(IN. H2O)           698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)         571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        38.3 (101.0)
  BLOWER REVOLUTIONS                         20996.
  TOT FLOW STD. CU. METRES(SCF)           205.7 ( 7265.)
  HC  SAMPLE METER/RANGE/PPM              13.9/11/  14.
  HC  BCKGRD METER/RANGE/PPM               4.5/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM              25.7/13/  24.
  CO  BCKGRD METER/RANGE/PPM               2.5/13/   2.
  CO2 SAMPLE METER/RANGE/PCT              45.1/ 3/  .77
  CO2 BCKGRD METER/RANGE/PCT               3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM              33.1/ 2/  33.
  NOX BCKGRD METER/RANGE/PPM                .4/ 2/   0.
  DILUTION FACTOR                            17.24
  HC  CONCENTRATION PPM                        10.
  CO  CONCENTRATION PPM                        21.
  CO2 CONCENTRATION PCT                        .73
  NOX CONCENTRATION PPM                       32.7
  HC  MASS GRAMS                              1.15
  CO  MASS GRAMS                              4.95
  CO2 MASS GRAMS                            2734.0
  NOX MASS GRAMS                             12.83
  PARTICULATE MASS GRAMS                      1.31
  RUN TIME              SECONDS               765.
      DFC, WET (DRY)                      .942 ( .926)
      SCF, WET (DRY)                     1.000 ( .976)
      VOL (SCM)                              205.7
      SAM BLR (SCM)                          43.82
      KM  (MEASURED)                         16.23

  TEST NUMBER,                              3A2H21
  BAROMETER,            MM HG                746.3
  HUMIDITY,             G/KG                  10.6
  TEMPERATURE,          DEG C                 25.0
   CARBON DIOXIDE,       G/KM                168.5
  FUEL CONSUMPTION,     L/100KM               6.28

  HYDROCARBONS,         G/KM                   .07
  CARBON MONOXIDE,      G/KM                   .31
  OXIDES OF NITROGEN,   G/KM                   .79
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                                       NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.   3A2N22   RUN   1                VEHICLE NO.3A                   TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT                 DATE    7/ 9/81                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                 DIESEL     EM-469-F
TRANSMISSION M5                            DYNO NO.      2                 ODOMETER  8085. KM( 5024. MILES)
                                           CVS NO.   3

BAROMETER 746.00 MM HG(29.37 IN HG)        DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  52. PCT                 ABS. HUMIDITY 10.1 GM/KG        NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)            706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)          574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)         35.0 ( 95.0)
  BLOWER REVOLUTIONS                          16423.
  TOT FLOW STD. CU. METRES(SCF)            161.7 ( 5708.)
  HC  SAMPLE METER/RANGE/PPM               20.5/11/  21.
  HC  BCKGRD METER/RANGE/PPM                4.7/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM               27.1/13/  25.
  CO  BCKGRD METER/RANGE/PPM                2.2/13/   2.
  CO2 SAMPLE METER/RANGE/PCT               20.1/ 3/  .32
  CO2 BCKGRD METER/RANGE/PCT                3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM               10.9/ 2/  11.
  NOX BCKGRD METER/RANGE/PPM                 .2/ 2/   0.
  DILUTION FACTOR                              40.88
  HC  CONCENTRATION PPM                          16.
  CO  CONCENTRATION PPM                          22.
  CO2 CONCENTRATION PCT                          .27
  NOX CONCENTRATION PPM                         10.7
  HC  MASS GRAMS                                1.48
  CO  MASS GRAMS                                4.21
  CO2 MASS GRAMS                               806.6
  NOX MASS GRAMS                                3.25
  PARTICULATE MASS GRAMS                         .57
  RUN TIME              SECONDS                 599.
       DFC, WET (DRY)                      .976 ( .959)
       SCF, WET (DRY)                     1.000 ( .980)
       VOL (SCM)                               161.7
       SAM BLR (SCM)                           34.20
       KM  (MEASURED)                           1.86

  TEST NUMBER,                                3A2N22
  BAROMETER,            MM HG                  746.0
  HUMIDITY,             G/KG                    10.1
  TEMPERATURE,          DEG C                   24.4
   CARBON DIOXIDE,       G/KM                  433.7
  FUEL CONSUMPTION,     L/100KM                16.33

  HYDROCARBONS,         G/KM                     .80
  CARBON MONOXIDE,      G/KM                    2.26
  OXIDES OF NITROGEN,   G/KM                    1.75
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                                          85 KPH VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   3A2S23   RUN   1                       VEHICLE NO.3A                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                       DATE    7/ 9/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                        BAG CART NO.  1                  DIESEL     EM-469-F
TRANSMISSION M5                                   DYNO NO.      2                  ODOMETER  8087. KM( 5025. MILES)
                                                  CVS NO.   3

BAROMETER 746.00 MM HG(29.37 IN HG)               DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                        ABS. HUMIDITY 10.4 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                        85 K

  BLOWER DIF P MM. H2O(IN. H2O)                   706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)                 576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)                38.9 (102.0)
  BLOWER REVOLUTIONS                                 32905.
  TOT FLOW STD. CU. METRES(SCF)                   321.5 (11352.)
  HC   SAMPLE METER/RANGE/PPM                     12.8/11/  13.
  HC   BCKGRD METER/RANGE/PPM                      4.5/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                     22.7/13/  21.
  CO   BCKGRD METER/RANGE/PPM                       .9/13/   1.
  CO2  SAMPLE METER/RANGE/PCT                     48.8/ 3/  .84
  CO2  BCKGRD METER/RANGE/PCT                      3.0/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                     35.2/ 2/  35.
  NOX  BCKGRD METER/RANGE/PPM                       .2/ 2/   0.
  DILUTION FACTOR                                      15.81
  HC   CONCENTRATION PPM                                 9.
  CO   CONCENTRATION PPM                                19.
  CO2  CONCENTRATION PCT                                .80
  NOX  CONCENTRATION PPM                               35.0
  HC   MASS GRAMS                                       1.59
  CO   MASS GRAMS                                       7.22
  CO2  MASS GRAMS                                    4715.1
  NOX  MASS GRAMS                                      21.29
  PARTICULATE MASS GRAMS                                2.08
  RUN TIME                 SECONDS                    1200.
       DFC, WET (DRY)                               .937 ( .922)
       SCF, WET (DRY)                              1.000 ( .976)
       VOL (SCM)                                      321.5
       SAM BLR (SCM)                                  68.45
       KM  (MEASURED)                                 28.37

  TEST NUMBER,                                      3A2S21
  BAROMETER,               MM HG                     746.0
  HUMIDITY,                G/KG                       10.4
  TEMPERATURE,             DEG C                      25.6
   CARBON DIOXIDE,          G/KM                     166.2
  FUEL CONSUMPTION,        L/100KM                    6.19

  HYDROCARBONS,            G/KM                        .06
  CARBON MONOXIDE,         G/KM                        .25
  OXIDES OF NITROGEN,      G/KM                        .75
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                              FTP    VEHICLE EMISSIONS RESULTS
                                      PROJECT 05-4874-001

TEST NO.   3A2F24    RUN   2          VEHICLE NO.3A
VEHICLE MODEL        TC FIAT          DATE     7/10/81                       TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4            BAG CART NO. 1 / CVS NO.  3            ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
TRANSMISSION M5                       DYNO NO.       1                       DIESEL      EM-469-F
                                                                             ODOMETER  8121. KM( 5046. MILES)
BAROMETER 745.74 MM HG(29.36 IN HG)   DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  60. PCT            ABS. HUMIDITY 12.1 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.05
BAG RESULTS
  BAG NUMBER                               1                  2                   3                   4
  DESCRIPTION                       COLD TRANSIENT        STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)     698.5 (27.5)       701.0 (27.6)        698.5 (27.5)        701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)   571.5 (22.5)       574.0 (22.6)        571.5 (22.5)        574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)  37.8 (100.0)       37.8 (100.0)        37.2 ( 99.0)        37.8 (100.0)
  BLOWER REVOLUTIONS                   13852.             23815.              13849.              23807.
  TOT FLOW STD. CU. METRES(SCF)     135.8 ( 4794.)     233.4 ( 8241.)      135.8 ( 4796.)      233.3 ( 8237.)
  HC   SAMPLE METER/RANGE/PPM       35.4/11/  35.      22.1/11/  22.       20.6/11/  21.       19.7/11/  20.
  HC   BCKGRD METER/RANGE/PPM        8.5/ 1/   9.       6.2/ 1/   6.        6.2/ 1/   6.        5.5/ 1/   6.
  CO   SAMPLE METER/RANGE/PPM       48.8/13/  46.      34.1/13/  31.       31.6/13/  29.       31.5/13/  29.
  CO   BCKGRD METER/RANGE/PPM        6.5/13/   6.       5.8/13/   5.        4.7/13/   4.        4.0/13/   4.
  CO2  SAMPLE METER/RANGE/PCT       40.9/ 3/  .69      29.1/ 3/  .48       36.1/ 3/  .61       28.3/ 3/  .47
  CO2  BCKGRD METER/RANGE/PCT        3.6/ 3/  .06       3.3/ 3/  .05        3.5/ 3/  .05        3.6/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM       28.0/ 2/  28.      18.8/ 2/  19.       23.6/ 2/  24.       17.8/ 2/  18.
  NOX  BCKGRD METER/RANGE/PPM         .6/ 2/   1.        .6/ 2/   1.         .4/ 2/   0.         .5/ 2/   1.
  DILUTION FACTOR                       19.08              27.63               21.94               28.49
  HC   CONCENTRATION PPM                27.                16.                 15.                 14.
  CO   CONCENTRATION PPM                39.                26.                 24.                 25.
  CO2  CONCENTRATION PCT                  .64                .43                 .55                 .41
  NOX  CONCENTRATION PPM                27.4               18.2                23.2                17.3
  HC   MASS GRAMS                        2.14               2.17                1.15                1.94
  CO   MASS GRAMS                        6.17               6.97                3.83                6.73
  CO2  MASS GRAMS                     1596.4             1841.4              1379.2              1760.7
  NOX  MASS GRAMS                        7.46               8.52                6.31                8.09
  PARTICULATE MASS GRAMS                 1.05               1.68                 .87                1.05

  HC   GRAMS/KM                           .37                .35                 .20                 .31
  CO   GRAMS/KM                          1.07               1.13                 .66                1.08
  CO2  GRAMS/KM                        276.2              297.9               238.1               283.1
  NOX  GRAMS/KM                          1.29               1.38                1.09                1.30
  FUEL CONSUMPTION BY CD L/100KM        10.36              11.17                8.90               10.61

  RUN TIME             SECONDS         505.               868.                505.                868.
  MEASURED DISTANCE    KM                5.78               6.18                5.79                6.22
  SCF, DRY                               .974               .976                .975                .976
      DFC, WET (DRY)                            .958 ( .939)                            .961 ( .943)
      SCF, WET (DRY)                           1.000 ( .976)                           1.000 ( .976)
      VOL (SCM)                                       369.2                                   369.1
      SAM BLR (SCM)                                    78.57                                   78.53
      KM  (MEASURED)                                   11.96                                   12.01
      FUEL CONSUMPTION L/100KM                         10.78                                    9.79

COMPOSITE RESULTS
   TEST NUMBER            3A2F24                                                   3-BAG      (4-BAG)
   BAROMETER    MM HG      745.7              CARBON DIOXIDE        G/KM          276.9     ( 272.6)
   HUMIDITY     G/KG        12.1              FUEL CONSUMPTION      L/100KM        10.38     ( 10.21)
   TEMPERATURE  DEG C       25.0              HYDROCARBONS (THC)    G/KM             .31     (   .30)
                                              CARBON MONOXIDE       G/KM             .99     (   .97)
                                              OXIDES OF NITROGEN    G/KM            1.28     (  1.26)
                                              PARTICULATES          G/KM            .219     (  .189)
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                                          HFET   VEHICLE EMISSIONS RESULTS
                                                  PROJECT 05-4874-001

TEST NO.   3A2H25   RUN   2                    VEHICLE NO.3A                       TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                    DATE     7/10/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                     DIESEL     EM-469-F
TRANSMISSION M5                                DYNO NO.      2                     ODOMETER  8143. KM( 5060. MILES)
                                               CVS NO.   3

BAROMETER 745.49 MM HG(29.35 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  56. PCT                     ABS. HUMIDITY 11.3 GM/KG            NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
  TEST CYCLE                                      HFET

  BLOWER DIF P MM. H2O(IN. H2O)                701.0 (27.6)
  BLOWER INLET P MM. H2O(IN. H2O)              574.0 (22.6)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.8 (100.0)
  BLOWER REVOLUTIONS                              20996.
  TOT FLOW STD. CU. METRES(SCF)                205.5 ( 7258.)
  HC   SAMPLE METER/RANGE/PPM                  15.6/11/  16.
  HC   BCKGRD METER/RANGE/PPM                   5.0/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                  27.3/13/  25.
  CO   BCKGRD METER/RANGE/PPM                   3.2/13/   3.
  CO2  SAMPLE METER/RANGE/PCT                  46.2/ 3/  .79
  CO2  BCKGRD METER/RANGE/PCT                   3.5/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM                  31.9/ 2/  32.
  NOX  BCKGRD METER/RANGE/PPM                    .6/ 2/   1.
  DILUTION FACTOR                                 16.79
  HC   CONCENTRATION PPM                          11.
  CO   CONCENTRATION PPM                          22.
  CO2  CONCENTRATION PCT                          .74
  NOX  CONCENTRATION PPM                         31.3
  HC   MASS GRAMS                                 1.29
  CO   MASS GRAMS                                 5.15
  CO2  MASS GRAMS                              2799.4
  NOX  MASS GRAMS                                12.58
  PARTICULATE MASS GRAMS                          1.33
  RUN TIME             SECONDS                  765.
       DFC, WET (DRY)                          .940 ( .923)
       SCF, WET (DRY)                         1.000 ( .975)
       VOL (SCM)                                205.5
       SAM BLR (SCM)                             43.65
       KM  (MEASURED)                            15.92

  TEST NUMBER,                                3A2H25
  BAROMETER,           MM HG                   745.5
  HUMIDITY,            G/KG                     11.3
  TEMPERATURE,         DEG C                    25.0
   CARBON DIOXIDE,      G/KM                   175.9
  FUEL CONSUMPTION,    L/100KM                  6.56

  HYDROCARBONS,        G/KM                      .08
  CARBON MONOXIDE,     G/KM                      .32
  OXIDES OF NITROGEN,  G/KM                      .79
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                                        NYCC   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001

TEST NO.    3A2N26    RUN   2                VEHICLE NO.3A                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                  DATE     7/10/81                 ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1                  DIESEL      EM-469-F
TRANSMISSION M5                              DYNO NO.      2                  ODOMETER  8159. KM( 5070. MILES)
                                             CVS NO.   3

BAROMETER 745.49 MM HG(29.35 IN HG)          DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  55. PCT                   ABS. HUMIDITY 10.4 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                   NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)
  BLOWER REVOLUTIONS                           16439.
  TOT FLOW STD. CU. METRES(SCF)              161.5 ( 5702.)
  HC   SAMPLE METER/RANGE/PPM                20.7/11/  21.
  HC   BCKGRD METER/RANGE/PPM                 4.9/ 1/   5.
  CO   SAMPLE METER/RANGE/PPM                27.6/13/  25.
  CO   BCKGRD METER/RANGE/PPM                 2.8/13/   3.
  CO2  SAMPLE METER/RANGE/PCT                20.5/ 3/  .33
  CO2  BCKGRD METER/RANGE/PCT                 3.9/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM                11.0/ 2/  11.
  NOX  BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                               40.04
  HC   CONCENTRATION PPM                        16.
  CO   CONCENTRATION PPM                        22.
  CO2  CONCENTRATION PCT                        .27
  NOX  CONCENTRATION PPM                       10.5
  HC   MASS GRAMS                               1.49
  CO   MASS GRAMS                               4.19
  CO2  MASS GRAMS                             803.5
  NOX  MASS GRAMS                               3.21
  PARTICULATE MASS GRAMS                        .66
  RUN TIME               SECONDS               599.
       DFC, WET (DRY)                        .975 ( .958)
       SCF, WET (DRY)                       1.000 ( .979)
       VOL (SCM)                               161.5
       SAM BLR (SCM)                           34.24
       KM  (MEASURED)                           1.92

  TEST NUMBER,                                3A2N26
  BAROMETER,              MM HG                745.5
  HUMIDITY,              G/KG                   10.4
  TEMPERATURE,           DEG C                  23.9
   CARBON DIOXIDE,        G/KM                 419.1
  FUEL CONSUMPTION,     L/100KM                15.78

  HYDROCARBONS,          G/KM                    .78
  CARBON MONOXIDE,       G/KM                   2.18
  OXIDES OF NITROGEN,    G/KM                   1.68
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                                   85 KPH VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001

TEST NO.   3A2S27    RUN   2                  VEHICLE NO.3A
VEHICLE MODEL        TC FIAT                  DATE     7/10/81                TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    BAG CART NO.  1                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                               DYNO NO.      2                 DIESEL     EM-469-F
                                              CVS NO.    3                    ODOMETER  8161. KM( 5071. MILES)

BAROMETER 745.49 MM HG(29.35 IN HG)           DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  56. PCT                    ABS. HUMIDITY 11.3 GM/KG        NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
   TEST CYCLE                                   85 K

   BLOWER DIF P MM. H2O(IN. H2O)              706.1 (27.8)
   BLOWER INLET P MM. H2O(IN. H2O)            579.1 (22.8)
   BLOWER INLET TEMP. DEG. C(DEG. F)           37.8 (100.0)
   BLOWER REVOLUTIONS                            32903.
   TOT FLOW STD. CU. METRES(SCF)              322.0 (11369.)
   HC   SAMPLE METER/RANGE/PPM                13.3/11/  13.
   HC   BCKGRD METER/RANGE/PPM                 4.9/ 1/   5.
   CO   SAMPLE METER/RANGE/PPM                27.0/13/  25.
   CO   BCKGRD METER/RANGE/PPM                 2.6/13/   2.
   CO2  SAMPLE METER/RANGE/PCT                50.4/ 3/  .87
   CO2  BCKGRD METER/RANGE/PCT                 3.8/ 3/  .06
   NOX  SAMPLE METER/RANGE/PPM                33.3/ 2/  33.
   NOX  BCKGRD METER/RANGE/PPM                  .7/ 2/   1.
   DILUTION FACTOR                                15.25
   HC   CONCENTRATION PPM                            9.
   CO   CONCENTRATION PPM                           22.
   CO2  CONCENTRATION PCT                           .82
   NOX  CONCENTRATION PPM                         32.6
   HC   MASS GRAMS                                  1.63
   CO   MASS GRAMS                                  8.14
   CO2  MASS GRAMS                              4836.0
   NOX  MASS GRAMS                                20.53
   PARTICULATE MASS GRAMS                          1.94
   RUN TIME                  SECONDS            1200.
        DFC, WET (DRY)                        .934 ( .918)
        SCF, WET (DRY)                       1.000 ( .974)
        VOL (SCM)                               322.0
        SAM BLR (SCM)                            68.44
        KM  (MEASURED)                           28.38

   TEST NUMBER,                                3A2S27
   BAROMETER,             MM HG                 745.5
   HUMIDITY,              G/KG                   11.3
   TEMPERATURE,           DEG C                  25.0
    CARBON DIOXIDE,        G/KM                 170.4
   FUEL CONSUMPTION,      L/100KM                6.35

   HYDROCARBONS,          G/KM                    .06
   CARBON MONOXIDE,       G/KM                    .29
   OXIDES OF NITROGEN,    G/KM                    .72
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                                   FTP    VEHICLE EMISSIONS RESULTS
                                            PROJECT 05-4874-001

TEST NO.   3A2F28   RUN   3                 VEHICLE NO.3A                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT                 DATE     7/13/81                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO. 1 / CVS NO.  3        DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                    ODOMETER  8191. KM( 5090. MILES)

BAROMETER 742.19 MM HG(29.22 IN HG)         DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  46. PCT                  ABS. HUMIDITY  9.3 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .95
BAG RESULTS
  BAG NUMBER                                   1                  2                  3                  4
  DESCRIPTION                            COLD TRANSIENT      STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)          698.5 (27.5)       698.5 (27.5)       703.6 (27.7)       703.6 (27.7)
  BLOWER INLET P MM. H2O(IN. H2O)        563.9 (22.2)       566.4 (22.3)       571.5 (22.5)       571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)       37.2 ( 99.0)       37.2 ( 99.0)       37.8 (100.0)       35.6 ( 96.0)
  BLOWER REVOLUTIONS                        13849.             23825.             13854.             23810.
  TOT FLOW STD. CU. METRES(SCF)          135.1 ( 4770.)     232.4 ( 8205.)     135.0 ( 4765.)     232.6 ( 8214.)
  HC  SAMPLE METER/RANGE/PPM             30.2/11/  30.      17.8/11/  18.      20.9/11/  21.      21.1/11/  21.
  HC  BCKGRD METER/RANGE/PPM              4.4/ 1/   4.       6.6/ 1/   7.       6.6/ 1/   7.       8.7/ 1/   9.
  CO  SAMPLE METER/RANGE/PPM             45.7/13/  43.      30.3/13/  28.      28.8/13/  26.      28.9/13/  27.
  CO  BCKGRD METER/RANGE/PPM              1.5/13/   1.       2.4/13/   2.       3.4/13/   3.       3.0/13/   3.
  CO2 SAMPLE METER/RANGE/PCT             40.4/ 3/  .69      28.4/ 3/  .47      34.5/ 3/  .58      27.9/ 3/  .46
  CO2 BCKGRD METER/RANGE/PCT              3.2/ 3/  .05       2.9/ 3/  .04       3.0/ 3/  .05       2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM             28.6/ 2/  29.      20.1/ 2/  20.      26.7/ 2/  27.      20.0/ 2/  20.
  NOX BCKGRD METER/RANGE/PPM               .7/ 2/   1.        .5/ 2/   1.       1.4/ 2/   1.       1.6/ 2/   2.
  DILUTION FACTOR                           19.35              28.40              23.05              28.93
  HC  CONCENTRATION PPM                     26.                11.                15.                13.
  CO  CONCENTRATION PPM                     40.                25.                23.                23.
  CO2 CONCENTRATION PCT                     .64                .42                .53                .42
  NOX CONCENTRATION PPM                    27.9               19.6               25.4               18.5
  HC  MASS GRAMS                            2.03               1.54               1.13               1.71
  CO  MASS GRAMS                            6.35               6.80               3.59               6.32
  CO2 MASS GRAMS                         1579.8             1805.6             1316.3             1770.0
  NOX MASS GRAMS                            6.89               8.32               6.25               7.84

  HC  GRAMS/KM                              .36                .25                .20                .28
  CO  GRAMS/KM                             1.11               1.10                .63               1.03
  CO2 GRAMS/KM                            276.5              292.9              230.6              287.4
  NOX GRAMS/KM                             1.21               1.35               1.10               1.27
  FUEL CONSUMPTION BY CB L/100KM          10.37              10.97               8.62              10.77

  RUN TIME              SECONDS            505.               868.               505.               868.
  MEASURED DISTANCE     KM                 5.71               6.17               5.71               6.16
  SCF, DRY                                 .979               .981               .980               .981
       DFC, WET (DRY)                            .959 ( .945)                          .962 ( .949)
       SCF, WET (DRY)                           1.000 ( .980)                         1.000 ( .981)
       VOL (SCM)                                       367.5                                  367.6
       SAM BLR (SCM)                                    78.26                                  78.24
       KM  (MEASURED)                                   11.88                                  11.86
       FUEL CONSUMPTION L/100KM                         10.68                                   9.74

COMPOSITE RESULTS
  TEST NUMBER           3A2F28                                                        3-BAG      (4-BAG)
  BAROMETER     MM HG    742.2                   CARBON DIOXIDE         G/KM          272.4     ( 270.8)
  HUMIDITY      G/KG       9.3                   FUEL CONSUMPTION       L/100KM       10.20     ( 10.14)
  TEMPERATURE   DEG C     25.0                   HYDROCARBONS (THC)     G/KM            .26     (   .27)
                                                 CARBON MONOXIDE        G/KM            .98     (   .95)
                                                 OXIDES OF NITROGEN     G/KM           1.25     (  1.23)
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                                         HFET   VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4874-001
TEST NO.   3A2H29   RUN   3
VEHICLE MODEL        TC FIAT                  VEHICLE NO.3A
ENGINE 2.0 L(122. CID) L-4                    DATE    7/13/81                 TEST WEIGHT  1361. KG( 3000. LBS)
TRANSMISSION M5                               BAG CART NO.  1                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
                                              DYNO NO.      2                 DIESEL    EM-469-F
                                              CVS NO.   3                     ODOMETER  8222. KM( 5109. MILES)
BAROMETER 741.68 MM HG(29.20 IN HG)
RELATIVE HUMIDITY  46. PCT                    DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
BAG RESULTS                                   ABS. HUMIDITY  9.7 GM/KG
  TEST CYCLE                                                                  NOX HUMIDITY CORRECTION FACTOR   .97
                                                  HFET
  BLOWER DIF P MM. H2O(IN. H2O)
  BLOWER INLET P MM. H2O(IN. H2O)              698.5 (27.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)            571.5 (22.5)
  BLOWER REVOLUTIONS                            37.8 (100.0)
  TOT FLOW STD. CU. METRES(SCF)                   21008.
  HC   SAMPLE METER/RANGE/PPM                  204.3 ( 7214.)
  HC   BCKGRD METER/RANGE/PPM                  18.7/11/  19.
  CO   SAMPLE METER/RANGE/PPM                   9.0/ 1/   9.
  CO   BCKGRD METER/RANGE/PPM                  25.0/13/  23.
  CO2  SAMPLE METER/RANGE/PCT                   1.9/13/   2.
  CO2  BCKGRD METER/RANGE/PCT                  45.2/ 3/  .78
  NOX  SAMPLE METER/RANGE/PPM                   3.2/ 3/  .05
  NOX  BCKGRD METER/RANGE/PPM                  35.7/ 2/  36.
  DILUTION FACTOR                               1.0/ 2/   1.
  HC   CONCENTRATION PPM                             17.19
  CO   CONCENTRATION PPM                              10.
  CO2  CONCENTRATION PCT                              21.
  NOX  CONCENTRATION PPM                              .73
  HC   MASS GRAMS                                    34.8
  CO   MASS GRAMS                                     1.20
  CO2  MASS GRAMS                                     4.90
  NOX  MASS GRAMS                                   2727.5
  RUN TIME                 SECONDS                   13.16
       DFC, WET (DRY)                                 766.
       SCF, WET (DRY)                              .942 ( .928)
       VOL (SCM)                                  1.000 ( .978)
       SAM BLR (SCM)                                 204.3
       KM  (MEASURED)                                43.42
                                                     16.21
  TEST NUMBER,
  BARAMETER,             MM HG                      3A2H29
  HUMIDITY,              G/KG                        741.7
  TEMPERATURE,           DEG C                         9.7
    CARBON DIOXIDE,       G/KM                        25.6
  FUEL CONSUMPTION,      L/100KM                     168.2
                                                      6.27
  HYDROCARBONS,          G/KM
  CARBON MONOXIDE,       G/KM                          .07
  OXIDES OF NITROGEN,    G/KM                          .30
                                                       .81
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                                     NYCC   VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.   3A2N30   RUN   3                  VEHICLE NO.3A                TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT                   DATE    7/13/81              ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO.  1              DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.       2             ODOMETER  8237. KM( 5118. MILES)
                                             CVS NO.   3

BAROMETER 741.68 MM HG(29.20 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  43. PCT                   ABS. HUMIDITY  9.0 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .95
BAG RESULTS
  TEST CYCLE                                        NYCC

  BLOWER DIF P MM. H2O(IN. H2O)              708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)            571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.6 ( 96.0)
  BLOWER REVOLUTIONS                            16439.
  TOT FLOW STD. CU. METRES(SCF)              160.3 ( 5661.)
  HC  SAMPLE METER/RANGE/PPM                 24.3/11/  24.
  HC  BCKGRD METER/RANGE/PPM                  8.8/ 1/   9.
  CO  SAMPLE METER/RANGE/PPM                 24.4/13/  22.
  CO  BCKGRD METER/RANGE/PPM                  1.4/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                 19.7/ 3/  .32
  CO2 BCKGRD METER/RANGE/PCT                  2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                 12.0/ 2/  12.
  NOX BCKGRD METER/RANGE/PPM                  1.1/ 2/   1.
  DILUTION FACTOR                                41.72
  HC  CONCENTRATION PPM                          16.
  CO  CONCENTRATION PPM                          21.
  CO2 CONCENTRATION PCT                          .27
  NOX CONCENTRATION PPM                          10.9
  HC  MASS GRAMS                                 1.45
  CO  MASS GRAMS                                 3.85
  CO2 MASS GRAMS                                802.1
  NOX MASS GRAMS                                 3.18
  RUN TIME              SECONDS                 599.
      DFC, WET (DRY)                         .976 ( .962)
      SCF, WET (DRY)                        1.000 ( .983)
      VOL (SCM)                                160.3
      SAM BLR (SCM)                            33.97
      KM  (MEASURED)                            1.89

  TEST NUMBER,                                 3A2N30
  BARONETER,            MM HG                  741.7
  HUMIDITY,             G/KG                     9.0
  TEMPERATURE,          DEG C                   25.6
   CARBON DIOXIDE,       G/KM                  423.4
  FUEL CONSUMPTION,     L/100KM                15.93

  HYDROCARBONS,         G/KM                     .77
  CARBON MONOXIDE,      G/KM                    2.03
  OXIDES OF NITROGEN,   G/KM                    1.68
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                                             85 KPH VEHICLE EMISSIONS RESULTS
                                                   PROJECT 05-4874-001

TEST NO.   3A2S31    RUN   3                    VEHICLE NO.3A                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        TC FIAT                    DATE     7/13/81                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                      DIESEL     EM-469-F
TRANSMISSION M5                                 DYNO NO.      2                      ODOMETER  8239. KM( 5119. MILES)
                                                CVS NO.   3

BAROMETER 741.43 MM HG(29.19 IN HG)             DRY BULB TEMP. 27.2 DEG C(81.0 DEG F)
RELATIVE HUMIDITY  42. PCT                      ABS. HUMIDITY  9.7 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .97
BAG RESULTS
  TEST CYCLE                                       85 K

  BLOWER DIF P MM. H2O(IN. H2O)                 703.6 (27.7)
  BLOWER INLET P MM. H2O(IN. H2O)               571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)              38.3 (101.0)
  BLOWER REVOLUTIONS                               32931.
  TOT FLOW STD. CU. METRES(SCF)                 319.5 (11283.)
  HC  SAMPLE METER/RANGE/PPM                    14.8/11/  15.
  HC  BCKGRD METER/RANGE/PPM                     6.4/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                    23.3/13/  21.
  CO  BCKGRD METER/RANGE/PPM                      .7/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                    49.7/ 3/  .86
  CO2 BCKGRD METER/RANGE/PCT                     3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    39.2/ 2/  39.
  NOX BCKGRD METER/RANGE/PPM                      .9/ 2/   1.
  DILUTION FACTOR                                  15.49
  HC   CONCENTRATION PPM                            9.
  CO   CONCENTRATION PPM                           20.
  CO2  CONCENTRATION PCT                           .81
  NOX  CONCENTRATION PPM                          38.4
  HC   MASS GRAMS                                  1.63
  CO   MASS GRAMS                                  7.46
  CO2  MASS GRAMS                               4762.4
  NOX  MASS GRAMS                                 22.71
  RUN TIME                  SECONDS              1200.
       DFC, WET (DRY)                          .935 ( .923)
       SCF, WET (DRY)                         1.000 ( .978)
       VOL (SCM)                                  319.5
       SAM BLR (SCM)                              67.93
       KM  (MEASURED)                             28.37

  TEST NUMBER,                                  3A2S31
  BAROMETER,             MM HG                   741.4
  HUMIDITY,              G/KG                      9.7
  TEMPERATURE,           DEG C                    27.2
   CARBON DIOXIDE,        G/KM                   167.9
  FUEL CONSUMPTION,      L/100KM                  6.26

  HYDROCARBONS,          G/KM                      .06
  CARBON MONOXIDE,       G/KM                      .26
  OXIDES OF NITROGEN,    G/KM                      .80
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APPENDIX F

TEST RESULTS,
FIAT TURBOCHARGED DIESEL
WITH CATALYTIC TRAP
FUELS EM-329-F AND EM-469-F

SUMMARY OF REGULATED EMISSIONS FROM FIAT TURBOCHARGED DIESEL RESEARCH VEHICLE WITH UNDERFLOOR CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code Test Type Date (1981) Run No.	3B1F01 3-b FTP 9/17 1	3B1F05 3-b FTP 9/18 2	3B1H02 HFET 9/17 1	3B1H06 HFET 9/18 2	3B1N03 NYCC 9/17 1	3B1N07 NYCC 9/18 2	3B1S04 85 kph 9/17 1	3B1S08 85 kph 9/18 2
HC, g/mi	0.13	0.11	0.02	0.03	0.19	0.19	0.00	0.00
CO, g/mi	0.43	0.43	0.08	0.08	0.66	0.61	0.05	0.05
NO_x, g/mi	1.88	1.85	1.16	1.14	2.53	2.72	1.14	1.21
Part., g/mi	0.10	0.09	0.05	0.06	0.16	0.13	0.05	0.06
Fuel, mi/gal	23.5	23.2	37.6	38.1	14.5	14.8	38.4	38.1

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                                        FTP    VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   3B1F01   RUN   1                    VEHICLE NO.3B                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U-CAT               DATE     9/17/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO. 1 / CVS NO.  3            DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.       2                       ODOMETER  8497. KM( 5280. MILES)

BAROMETER 743.20 MM HG(29.26 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  36. PCT                     ABS. HUMIDITY  7.3 GM/KG               NOX HUMIDITY CORRECTION FACTOR   .90
BAG RESULTS
  BAG NUMBER                                        1                    2                   3                    4
  DESCRIPTION                                COLD TRANSIENT         STABILIZED         HOT TRANSIENT         STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)               708.7 (27.9)         711.2 (28.0)        708.7 (27.9)         708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)             581.7 (22.9)         584.2 (23.0)        581.7 (22.9)         581.7 (22.9)
  BLOWER INLET TEMP. DEG. C(DEG. F)            35.0 ( 95.0)         34.4 ( 94.0)        36.1 ( 97.0)         36.1 ( 97.0)
  BLOWER REVOLUTIONS                            13859.               23805.              13861.               23799.
  TOT FLOW STD. CU. METRES(SCF)               136.1 ( 4806.)       234.0 ( 8261.)      135.9 ( 4797.)       233.3 ( 8237.)
  HC  SAMPLE METER/RANGE/PPM                  15.7/11/  16.         6.5/11/   7.        6.6/11/   7.         5.8/11/   6.
  HC  BCKGRD METER/RANGE/PPM                   3.8/ 1/   4.         3.9/ 1/   4.        3.6/ 1/   4.         3.6/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                  22.5/13/  21.         6.2/13/   6.        8.3/13/   7.         5.9/13/   5.
  CO  BCKGRD METER/RANGE/PPM                    .5/13/   0.          .6/13/   1.        2.3/13/   2.         1.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                  39.1/ 3/  .66        27.6/ 3/  .45       33.7/ 3/  .56        27.1/ 3/  .44
  CO2 BCKGRD METER/RANGE/PCT                   3.5/ 3/  .05         3.2/ 3/  .05        3.2/ 3/  .05         2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                  29.0/ 2/  29.        19.8/ 2/  20.       24.3/ 2/  24.        18.9/ 2/  19.
  NOX BCKGRD METER/RANGE/PPM                    .5/ 2/   1.          .3/ 2/   0.         .3/ 2/   0.          .3/ 2/   0.
  DILUTION FACTOR                                20.16                29.49               23.78                30.08
  HC  CONCENTRATION PPM                           12.                   3.                  3.                   2.
  CO  CONCENTRATION PPM                           20.                   5.                  5.                   4.
  CO2 CONCENTRATION PCT                           .61                  .41                 .52                  .40
  NOX CONCENTRATION PPM                          28.5                 19.5                24.0                 18.6
  HC  MASS GRAMS                                  .95                  .37                 .25                  .31
  CO  MASS GRAMS                                 3.11                 1.35                 .85                 1.02
  CO2 MASS GRAMS                               1520.1               1738.1              1281.5               1714.5
  NOX MASS GRAMS                                 6.67                 7.84                5.60                 7.46
  PARTICULATE MASS GRAMS                          .47                  .37                 .29                  .32

  HC  GRAMS/KM                                    .17                  .06                 .04                  .05
  CO  GRAMS/KM                                    .54                  .22                 .15                  .16
  CO2 GRAMS/KM                                  264.3                282.6               222.5                276.1
  NOX GRAMS/KM                                   1.16                 1.27                 .97                 1.20
  FUEL CONSUMPTION BY CB L/100KM                10.10                10.76                8.47                10.51

  RUN TIME                 SECONDS              505.                 868.                505.                 868.
  MEASURED DISTANCE        KM                   5.75                 6.15                5.76                 6.21
  SCF, DRY                                      .982                 .984                .983                 .984
       DFC, WET (DRY)                                  .960 ( .949)                              .964 ( .952)
       SCF, WET (DRY)                                 1.000 ( .983)                             1.000 ( .984)
       VOL (SCM)                                              370.1                                     369.1
       SAM BLR (SCM)                                          78.98                                     79.01
       KM  (MEASURED)                                         11.90                                     11.97
       FUEL CONSUMPTION L/100KM                               10.44                                      9.53

COMPOSITE RESULTS
  TEST NUMBER              3B1F01                                                          3-BAG      (4-BAG)
  BAROMETER     MM HG      743.2               CARBON DIOXIDE          G/KM               262.3     ( 260.4)
  HUMIDITY      G/KG         7.3               FUEL CONSUMPTION        L/100KM             9.99     (   9.92)
  TEMPERATURE   DEG C       25.0               HYDROCARBONS (THC)      G/KM                 .08     (    .07)
                                               CARBON MONOXIDE         G/KM                 .27     (    .25)
                                               OXIDES OF NITROGEN      G/KM                1.17     (   1.15)
                                               PARTICULATES            G/KM                .062     (   .059)
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                                    HFET   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001
TEST NO.   3B1H02   RUN   1
VEHICLE MODEL      TC FIAT U-CAT              VEHICLE NO.3B                  TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                    DATE     9/17/81               ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                               BAG CART NO.  1                DIESEL     EM-329-F
                                              DYNO NO.      2                ODOMETER  8521. KM( 5295. MILES)
                                              CVS NO.   3
BAROMETER 750.06 MM HG(29.53 IN HG)           DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  30. PCT                    ABS. HUMIDITY  6.3 GM/KG        NOX HUMIDITY CORRECTION FACTOR   .87
BAG RESULTS
  TEST CYCLE                                    HFET

  BLOWER DIF P MM. H2O(IN. H2O)               706.1 (27.8)
  BLOWER INLET P MM. H2O(IN. H2O)             579.1 (22.8)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             21009.
  TOT FLOW STD. CU. METRES(SCF)               207.5 ( 7325.)
  HC  SAMPLE METER/RANGE/PPM                   5.3/11/   5.
  HC  BCKGRD METER/RANGE/PPM                   3.5/ 1/   4.
  CO  SAMPLE METER/RANGE/PPM                   5.3/13/   5.
  CO  BCKGRD METER/RANGE/PPM                   1.3/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                  43.8/ 3/  .75
  CO2 BCKGRD METER/RANGE/PCT                   3.0/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  34.0/ 2/  34.
  NOX BCKGRD METER/RANGE/PPM                    .2/ 2/   0.
  DILUTION FACTOR                                17.87
  HC  CONCENTRATION PPM                            2.
  CO  CONCENTRATION PPM                            4.
  CO2 CONCENTRATION PCT                           .71
  NOX CONCENTRATION PPM                          33.8
  HC  MASS GRAMS                                  .24
  CO  MASS GRAMS                                  .86
  CO2 MASS GRAMS                               2679.7
  NOX MASS GRAMS                                11.71
  PARTICULATE MASS GRAMS                          .54
  RUN TIME                 SECONDS               766.
       DFC, WET (DRY)                         .944 ( .935)
       SCF, WET (DRY)                        1.000 ( .983)
       VOL (SCM)                                207.5
       SAM BLR (SCM)                            44.61
       KM  (MEASURED)                           16.31

  TEST NUMBER,                                 3B1H02
  BAROMETER,               MM HG               750.1
  HUMIDITY,                G/KG                  6.3
  TEMPERATURE,             DEG C                25.6
   CARBON DIOXIDE,          G/KM               164.3
  FUEL CONSUMPTION,        L/100KM              6.25

  HYDROCARBONS,            G/KM                  .01
  CARBON MONOXIDE,         G/KM                  .05
  OXIDES OF NITROGEN,      G/KM                  .72
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                                          NYCC   VEHICLE EMISSIONS RESULTS
                                                   PROJECT 05-4874-001

TEST NO.   3B1N03   RUN   1                    VEHICLE NO.3B                   TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U-CAT               DATE     9/17/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                 DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.      2                 ODOMETER  8536. KM( 5304. MILES)
                                               CVS NO.    3

BAROMETER 749.55 MM HG(29.51 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  30. PCT                     ABS. HUMIDITY  5.9 GM/KG        NOX HUMIDITY CORRECTION FACTOR   .86
BAG RESULTS
  TEST CYCLE                                         NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                  711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)                584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)               35.0 ( 95.0)
  BLOWER REVOLUTIONS                               16497.
  TOT FLOW STD. CU. METRES(SCF)                  163.3 ( 5767.)
  HC   SAMPLE METER/RANGE/PPM                    5.9/11/    6.
  HC   BCKGRD METER/RANGE/PPM                    3.6/ 1/    4.
  CO   SAMPLE METER/RANGE/PPM                    5.5/13/    5.
  CO   BCKGRD METER/RANGE/PPM                     .9/13/    1.
  CO2  SAMPLE METER/RANGE/PCT                   19.5/ 3/  .31
  CO2  BCKGRD METER/RANGE/PCT                    2.8/ 3/  .04
  NOX  SAMPLE METER/RANGE/PPM                   11.4/ 2/  11.
  NOX  BCKGRD METER/RANGE/PPM                     .3/ 2/   0.
  DILUTION FACTOR                                    42.64
  HC   CONCENTRATION PPM                                2.
  CO   CONCENTRATION PPM                                4.
  CO2  CONCENTRATION PCT                               .27
  NOX  CONCENTRATION PPM                              11.1
  HC   MASS GRAMS                                      .23
  CO   MASS GRAMS                                      .78
  CO2  MASS GRAMS                                    811.4
  NOX  MASS GRAMS                                     3.00
  PARTICULATE MASS GRAMS                               .19
  RUN TIME                   SECONDS                  601.
       DFC, WET (DRY)                             .977 ( .967)
       SCF, WET (DRY)                            1.000 ( .988)
       VOL (SCM)                                     163.3
       SAM BLR (SCM)                                 34.80
       KM  (MEASURED)                                 1.91

  TEST NUMBER,                                     3B1N03
  BAROMETER,                 MM HG                  749.6
  HUMIDITY,                  G/KG                     5.9
  TEMPERATURE,               DEG C                   25.0
   CARBON DIOXIDE,            G/KM                   425.1
  FUEL CONSUMPTION,          L/100KM                 16.20

  HYDROCARBONS,              G/KM                      .12
  CARBON MONOXIDE,           G/KM                      .41
  OXIDES OF NITROGEN,        G/KM                     1.57
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                                              85KPH  VEHICLE EMISSIONS RESULTS
                                                     PROJECT 05-4874-001

TEST NO.   3BIS04   RUN   1                         VEHICLE NO.3B
VEHICLE MODEL      TC FIAT U-CAT                    DATE     9/17/81                  TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                          BAG CART NO.  1                   ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                     DYNO NO.      2                   DIESEL     EM-329-F
                                                    CVS NO.   3                       ODOMETER  8530. KM( 5305. MILES)

BAROMETER 749.30 MM HG(29.50 IN HG)                 DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  33. PCT                          ABS. HUMIDITY  6.5 GM/KG
BAG RESULTS                                                                           NOX HUMIDITY CORRECTION FACTOR   .88
  TEST CYCLE
                                                       85KP
  BLOWER DIF P MM. H2O(IN. H2O)                      708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)                    581.7 (22.9)
  BLOWER INLET TEMP. DEG. C(DEG. F)                   38.3 (101.0)
  BLOWER REVOLUTIONS                                  32965.
  TOT FLOW STD. CU. METRES(SCF)                      324.9 (11472.)
  HC   SAMPLE METER/RANGE/PPM                        4.1/11/   4.
  HC   BCKGRD METER/RANGE/PPM                        3.8/ 1/   4.
  CO   SAMPLE METER/RANGE/PPM                        5.6/13/   5.
  CO   BCKGRD METER/RANGE/PPM                        2.9/13/   3.
  CO2  SAMPLE METER/RANGE/PCT                       47.0/ 3/  .81
  CO2  BCKGRD METER/RANGE/PCT                        2.8/ 3/  .04
  NOX  SAMPLE METER/RANGE/PPM                       37.5/ 2/  38.
  NOX  BCKGRD METER/RANGE/PPM                         .3/ 2/   0.
  DILUTION FACTOR                                     16.53
  HC   CONCENTRATION PPM                                 0.
  CO   CONCENTRATION PPM                                 2.
  CO2  CONCENTRATION PCT                                .77
  NOX  CONCENTRATION PPM                               37.2
  HC   MASS GRAMS                                       .09
  CO   MASS GRAMS                                       .94
  CO2  MASS GRAMS                                    4576.2
  NOX  MASS GRAMS                                     20.33
  PARTICULATE MASS GRAMS                                .95
  RUN TIME              SECONDS                      1201.
       DFC, WET (DRY)                                .940 ( .930)
       SCF, WET (DRY)                               1.000 ( .982)
       VOL (SCM)                                     324.9
       SAM BLR (SCM)                                 69.90

       KM  (MEASURED)                                20.45

  TEST NUMBER,                                      31 S04
  BAROMETER,             MM HG                       749.3
  HUMIDITY,              G/KG                          6.5
  TEMPERATURE,           DEG C                        25.0
   CARBON DIOXIDE,        G/KM                       160.9
  FUEL CONSUMPTION,      L/100KM                      6.12

  HYDROCARBONS,          G/KM                          .00
  CARBON MONOXIDE,       G/KM                          .03
  OXIDES OF NITROGEN,    G/KM                          .71
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                                       FTP    VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001

TEST NO.   3D1F05   RUN   2                   VEHICLE NO.3B                    TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT U-CAT            DATE     9/18/81                 ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO. 1 / CVS NO.  3      DIESEL     EM-329-F
TRANSMISSION M5                              DYNO NO.      2                  ODOMETER  8571. KM( 5326. MILES)

BAROMETER 753.07 MM HG(29.68 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  38. PCT                   ABS. HUMIDITY  7.3 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .90
BAG RESULTS
  BAG NUMBER                                       1                  2                  3                  4
  DESCRIPTION                               COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)              708.7 (27.9)       711.2 (28.0)       711.2 (28.0)       708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)            581.7 (22.9)       584.2 (23.0)       584.2 (23.0)       581.7 (22.9)
  BLOWER INLET TEMP. DEG. C(DEG. F)           35.0 ( 95.0)       35.0 ( 95.0)       36.1 ( 97.0)       36.7 ( 98.0)
  BLOWER REVOLUTIONS                            13063.             23826.             13851.             23808.
  TOT FLOW STD. CU. METRES(SCF)              138.0 ( 4872.)     237.1 ( 8372.)     137.6 ( 4858.)     236.4 ( 8346.)
  HC  SAMPLE METER/RANGE/PPM                 13.7/11/  14.       6.3/11/   6.       6.7/11/   7.       6.1/11/   6.
  HC  BCKGRD METER/RANGE/PPM                  4.4/ 1/   4.       3.6/ 1/   4.       3.4/ 1/   3.       3.4/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                 28.0/13/  26.      11.4/13/  10.       9.7/13/   9.       7.6/13/   7.
  CO  BCKGRD METER/RANGE/PPM                  7.6/13/   7.       6.0/13/   5.       3.2/13/   3.       2.6/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                 38.7/ 3/  .65      27.1/ 3/  .44      34.3/ 3/  .57      26.9/ 3/  .44
  CO2 BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05       2.7/ 3/  .04       3.4/ 3/  .05       3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                 27.6/ 2/  28.      19.1/ 2/  19.      24.9/ 2/  25.      18.7/ 2/  19.
  NOX BCKGRD METER/RANGE/PPM                   .5/ 2/   1.        .5/ 2/   1.        .7/ 2/   1.        .7/ 2/   1.
  DILUTION FACTOR                                20.38              30.05              23.32              30.31
  HC  CONCENTRATION PPM                          10.                 3.                 3.                 3.
  CO  CONCENTRATION PPM                          19.                 5.                 6.                 4.
  CO2 CONCENTRATION PCT                          .61                .40                .52                .39
  NOX CONCENTRATION PPM                          27.1               18.6               24.2               18.0
  HC  MASS GRAMS                                  .76                .38                .28                .38
  CO  MASS GRAMS                                 3.11               1.36                .93               1.23
  CO2 MASS GRAMS                               1533.6             1755.6             1317.7             1696.0
  NOX MASS GRAMS                                 6.44               7.60               5.74               7.33
  PARTICULATE MASS GRAMS                          .45                .35                .29                .31

  HC  GRAMS/KM                                    .13                .06                .05                .06
  CO  GRAMS/KM                                    .54                .22                .16                .20
  CO2 GRAMS/KM                                  266.9              285.5              229.7              274.0
  NOX GRAMS/KM                                   1.12               1.24               1.00               1.18
  FUEL CONSUMPTION BY CB L/100KM                10.19              10.87               8.75              10.43

  RUN TIME                SECONDS               505.               868.               505.               868.
  MEASURED DISTANCE       KM                    5.74               6.15               5.74               6.19
  SCF, DRY                                      .982               .984               .982               .984
      DFC, WET (DRY)                                   .961 ( .949)                          .963 ( .952)
      SCF, WET (DRY)                                  1.000 ( .983)                         1.000 ( .983)
      VOL (SCM)                                              375.1                                 373.9
      SAM BLR (SCM)                                          79.77                                 79.67
      KM  (MEASURED)                                         11.89                                 11.93
      FUEL CONSUMPTION L/100KM                               10.55                                  9.62

COMPOSITE RESULTS
  TEST NUMBER              3D1F05                                                           3-BAG       (4-BAG)
  BAROMETER      MM HG    753.9                      CARBON DIOXIDE       G/KM             266.3      ( 263.0)
  HUMIDITY       G/KG       7.3                      FUEL CONSUMPTION     L/100KM           10.15      ( 10.02)
  TEMPERATURE    DEG C     24.4                      HYDROCARBONS (THC)   G/KM                .07      (   .07)
                                                     CARBON MONOXIDE      G/KM                .27      (   .27)
                                                     OXIDES OF NITROGEN   G/KM               1.15      (  1.13)
                                                     PARTICULATES         G/KM               .059      (  .057)
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                                    HFET   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   3B1H06   RUN   2                    VEHICLE NO.3D                      TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT U-CAT              DATE      9/18/81                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                     BAG CART NO.  1                    DIESEL     EM-329-F
TRANSMISSION M5                                DYNO NO.        2                  ODOMETER  8594. KM( 5340. MILES)
                                               CVS NO.    3

BAROMETER 753.87 MM HG(29.68 IN HG)            DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  36. PCT                     ABS. HUMIDITY  7.1 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .89
BAG RESULTS
  TEST CYCLE                                      HFET

  BLOWER DIF P MM. H2O(IN. H2O)                708.7 (27.9)
  BLOWER INLET P MM. H2O(IN. H2O)              581.7 (22.9)
  BLOWER INLET TEMP. DEG. C(DEG. F)             37.2 ( 99.0)
  BLOWER REVOLUTIONS                              20098.
  TOT FLOW STD. CU. METRES(SCF)                200.9 ( 7094.)
  HC   SAMPLE METER/RANGE/PPM                   5.3/11/   5.
  HC   BCKGRD METER/RANGE/PPM                   3.3/ 1/   3.
  CO   SAMPLE METER/RANGE/PPM                   5.7/13/   5.
  CO   BCKGRD METER/RANGE/PPM                   1.7/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                   45.0/ 3/  .77
  CO2 BCKGRD METER/RANGE/PCT                    2.9/ 3/  .04
  NOX SAMPLE METER/RANGE/PPM                   34.9/ 2/  35.
  NOX BCKGRD METER/RANGE/PPM                     .7/ 2/   1.
  DILUTION FACTOR                                 17.34
  HC   CONCENTRATION PPM                             2.
  CO   CONCENTRATION PPM                             4.
  CO2 CONCENTRATION PCT                             .73
  NOX CONCENTRATION PPM                           34.2
  HC   MASS GRAMS                                    .25
  CO   MASS GRAMS                                    .84
  CO2 MASS GRAMS                                2684.1
  NOX MASS GRAMS                                  11.76
  PARTICULATE MASS GRAMS                            .58
  RUN TIME              SECONDS                   765.
       DFC, WET (DRY)                           .942 ( .931)
       SCF, WET (DRY)                          1.000 ( .981)
       VOL (SCM)                                 200.9
       SAM BLR (SCM)                              44.20
       KM  (MEASURED)                             16.54

  TEST NUMBER,                                  3B1H06
  BAROMETER,             MM HG                   753.9
  HUMIDITY,              G/KG                      7.1
  TEMPERATURE,           DEG C                    25.0
   CARBON DIOXIDE,        G/KM                   162.3
  FUEL CONSUMPTION,      L/100KM                  6.17

  HYDROCARBONS,          G/KM                      .02
  CARBON MONOXIDE,       G/KM                      .05
  OXIDES OF NITROGEN,    G/KM                      .71
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                                   NYCC   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   3B1N07   RUN   2                VEHICLE NO.3B                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL        TC FIAT U-CAT         DATE    9/18/81                      ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                      DIESEL     EM-329-F
TRANSMISSION M5                            DYNO NO.      2                      ODOMETER  8610. KM( 5350. MILES)
                                           CVS NO.   3

BAROMETER 753.87 MM HG(29.68 IN HG)        DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY  48. PCT                 ABS. HUMIDITY  8.9 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .94
BAG RESULTS
  TEST CYCLE                                  NYCC

  BLOWER DIF P MM. H2O(IN. H2O)            711.2 (28.0)
  BLOWER INLET P MM. H2O(IN. H2O)          584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)         33.3 ( 92.0)
  BLOWER REVOLUTIONS                         16405.
  TOT FLOW STD. CU. METRES(SCF)            164.3 ( 5801.)
  HC  SAMPLE METER/RANGE/PPM                 5.6/11/   6.
  HC  BCKGRD METER/RANGE/PPM                 3.2/ 1/   3.
  CO  SAMPLE METER/RANGE/PPM                 5.4/13/   5.
  CO  BCKGRD METER/RANGE/PPM                 1.1/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                19.6/ 3/  .31
  CO2 BCKGRD METER/RANGE/PCT                 3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                11.5/ 2/  12.
  NOX BCKGRD METER/RANGE/PPM                  .5/ 2/   1.
  DILUTION FACTOR                              42.42
  HC  CONCENTRATION PPM                          2.
  CO  CONCENTRATION PPM                          4.
  CO2 CONCENTRATION PCT                         .27
  NOX CONCENTRATION PPM                        11.0
  HC  MASS GRAMS                                .23
  CO  MASS GRAMS                                .73
  CO2 MASS GRAMS                              807.7
  NOX MASS GRAMS                               3.26
  PARTICULATE MASS GRAMS                        .16
  RUN TIME                  SECONDS            598.
       DFC, WET (DRY)                     .976 ( .961)
       SCF, WET (DRY)                    1.000 ( .982)
       VOL (SCM)                               164.3
       SAM BLR (SCM)                           35.18
       KM  (MEASURED)                           1.93

  TEST NUMBER,                                3B1N07
  BARONETER,              MM HG                753.9
  HUMIDITY,               G/KG                   8.9
  TEMPERATURE,            DEG C                 23.9
   CARBON DIOXIDE,        G/KM                 417.4
  FUEL CONSUMPTION,       L/100KM              15.90

  HYDROCARBONS,           G/KM                   .12
  CARBON MONOXIDE,        G/KM                   .38
  OXIDES OF NITROGEN,     G/KM                  1.69
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                                           85 KPH VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001
TEST NO.   3B1S08   RUN   2
VEHICLE MODEL       TC FIAT U-CAT                 VEHICLE NO.3B
ENGINE 2.0 L(122. CID) L-4                        DATE     9/18/81                    TEST WEIGHT  1361. KG( 3000. LBS)
TRANSMISSION M5                                   BAG CART NO.  1                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
                                                  DYNO NO.      2                     DIESEL     EM-329-F
                                                  CVS NO.   3                         ODOMETER  8612. KM( 5351. MILES)
BAROMETER 753.36 MM HG(29.66 IN HG)
RELATIVE HUMIDITY  38. PCT                        DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
BAG RESULTS                                       ABS. HUMIDITY  7.4 GM/KG           NOX HUMIDITY CORRECTION FACTOR   .90
  TEST CYCLE
                                                    85 K
   BLOWER DIF P MM. H2O(IN. H2O)                 708.7 (27.9)
   BLOWER INLET P MM. H2O(IN. H2O)               581.7 (22.9)
   BLOWER INLET TEMP. DEG. C(DEG. F)              37.8 (100.0)
   BLOWER REVOLUTIONS                               32925.
   TOT FLOW STD. CU. METRES(SCF)                 327.0 (11546.)
   HC  SAMPLE METER/RANGE/PPM                     4.0/11/   4.
   HC  BCKGRD METER/RANGE/PPM                     3.5/ 1/   4.
   CO  SAMPLE METER/RANGE/PPM                     3.5/13/   3.
   CO  BCKGRD METER/RANGE/PPM                      .8/13/   1.
   CO2 SAMPLE METER/RANGE/PCT                    47.1/ 3/  .81
   CO2 BCKGRD METER/RANGE/PCT                     2.9/ 3/  .04
   NOX SAMPLE METER/RANGE/PPM                    38.2/ 2/  38.
   NOX BCKGRD METER/RANGE/PPM                      .3/ 2/   0.
   DILUTION FACTOR                                   16.50
   HC  CONCENTRATION PPM                                1.
   CO  CONCENTRATION PPM                                2.
   CO2 CONCENTRATION PCT                               .77
   NOX CONCENTRATION PPM                             37.9
   HC  MASS GRAMS                                      .13
   CO  MASS GRAMS                                      .91
   CO2 MASS GRAMS                                  4608.5
   NOX MASS GRAMS                                    21.35
   PARTICULATE MASS GRAMS                             1.11
   RUN TIME              SECONDS                    1199.
       DFC, WET (DRY)                              .939 ( .928)
       SCF, WET (DRY)                             1.000 ( .980)
       VOL (SCM)                                    327.0
       SAM BLR (SCM)                                 70.37
       KM  (MEASURED)                                28.41

   TEST NUMBER,                                     3B1S08
   BAROMETER,            MM HG                      753.4
   HUMIDITY,             G/KG                         7.4
   TEMPERATURE,          DEG C                       24.4
    CARBON DIOXIDE,       G/KM                      162.2
   FUEL CONSUMPTION,     L/100KM                      6.17

   HYDROCARBONS,         G/KM                         .00
   CARBON MONOXIDE,      G/KM                         .03
   OXIDES OF NITROGEN,   G/KM                         .75
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SUMMARY OF REGULATED EMISSIONS FROM FIAT TURBOCHARGED DIESEL RESEARCH VEHICLE WITH UNDERFLOOR CATALYTIC TRAP, EM-469-F FUEL

Test Code	3B2F35	3B2F39	3B2H36	3B2H40	3B2N37	3B2N41	3B2S38	3B2S42
Test Type	3-b FTP	3-b FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Date (1981)	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24
Run No.	1	2	1	2	1	2	1	2
HC, g/mi	0.18	0.19	0.03	0.03	0.31	0.29	0.00	0.02
CO, g/mi	0.43	0.43	0.08	0.08	0.76	0.68	0.05	0.05
NO_x, g/mi	2.06	2.11	1.35	1.32	2.98	2.85	1.37	1.32
Part., g/mi	0.09	0.09	0.07	0.06	0.16	0.18	0.08	0.08
Fuel, mi/gal	23.8	23.5	36.8	36.9	14.8	14.8	38.1	38.3

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                                    FTP    VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   3B2F35   RUN   1                 VEHICLE NO.3B                          TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U-CAT            DATE     9/23/81                       ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO. 1 / CVS NO.  3            DIESEL    EM-469-F
TRANSMISSION M5                             DYNO NO.       2                       ODOMETER  8951. KM( 5562. MILES)

BAROMETER 743.97 MM HG(29.29 IN HG)         DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  59. PCT                  ABS. HUMIDITY 11.6 GM/KG               NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  BAG NUMBER                                      1                 2                    3                    4
  DESCRIPTION                               COLD TRANSIENT     STABILIZED         HOT TRANSIENT          STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             693.4 (27.3)       698.5 (27.5)       693.4 (27.3)         698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           566.4 (22.3)       571.5 (22.5)       566.4 (22.3)         571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)       37.2 ( 99.0)       37.2 ( 99.0)         38.3 (101.0)
  BLOWER REVOLUTIONS                           13846.             23830.             13844.               23792.
  TOT FLOW STD. CU. METRES(SCF)             135.9 ( 4797.)     233.4 ( 8240.)     135.6 ( 4789.)       232.5 ( 8211.)
  HC  SAMPLE METER/RANGE/PPM                26.5/11/  27.      10.3/11/  10.      10.2/11/  10.         9.0/11/   9.
  HC  BCKGRD METER/RANGE/PPM                 8.1/ 1/   8.       6.5/ 1/   7.       6.5/ 1/   7.         6.1/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                38.1/13/  35.      14.2/13/  13.      12.2/13/  11.        10.1/13/   9.
  CO  BCKGRD METER/RANGE/PPM                11.7/13/  11.       9.7/13/   9.       6.3/13/   6.         5.6/13/   5.
  CO2 SAMPLE METER/RANGE/PCT                40.0/ 3/  .68      28.8/ 3/  .47      33.0/ 3/  .55        28.2/ 3/  .46
  CO2 BCKGRD METER/RANGE/PCT                 3.5/ 3/  .05       3.3/ 3/  .05       3.5/ 3/  .05         3.6/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                28.3/ 2/  28.      19.7/ 2/  20.      22.5/ 2/  23.        19.9/ 2/  20.
  NOX BCKGRD METER/RANGE/PPM                  .8/ 2/   1.        .4/ 2/   0.        .4/ 2/   0.          .6/ 2/   1.
  DILUTION FACTOR                             19.60              28.12              24.30                28.79
  HC  CONCENTRATION PPM                       19.                 4.                 4.                   3.
  CO  CONCENTRATION PPM                       24.                 4.                 5.                   4.
  CO2 CONCENTRATION PCT                       .63                .43                .50                  .41
  NOX CONCENTRATION PPM                      27.5               19.3               22.1                 19.3
  HC  MASS GRAMS                             1.48                .54                .31                  .42
  CO  MASS GRAMS                             3.86               1.14                .85                 1.11
  CO2 MASS GRAMS                           1559.2             1818.4             1236.7               1747.4
  NOX MASS GRAMS                             7.37               8.08               5.91                 8.85
  PARTICULATE MASS GRAMS                      .43                .33                .29                  .31

  HC  GRAMS/KM                                .25                .09                .05                  .07
  CO  GRAMS/KM                                .66                .18                .15                  .18
  CO2 GRAMS/KM                              268.2              291.8              213.3                279.7
  NOX GRAMS/KM                               1.27               1.43               1.02                 1.42
  FUEL CONSUMPTION BY CB L/100KM            10.03              10.86               7.93                10.40

  RUN TIME                  SECONDS          504.               868.               504.                 867.
  MEASURED DISTANCE         KM               5.81               6.23               5.80                 6.25
  SCF, DRY                                   .975               .977               .976                 .977
      DFC, WET (DRY)                                  .959 ( .940)                         .963 ( .945)
      SCF, WET (DRY)                                 1.000 ( .976)                        1.000 ( .976)
      VOL (SCM)                                             369.2                                368.2
      SAM BLR (SCM)                                          78.36                                78.28
      KM  (MEASURED)                                         12.05                                12.05
      FUEL CONSUMPTION L/100KM                               10.46                                 9.21

COMPOSITE RESULTS
  TEST NUMBER              3B2F35                                                                3-BAG      (4-BAG)
  BAROMETER      MM HG      744.0                   CARBON DIOXIDE           G/KM                265.3     ( 261.8)
  HUMIDITY       G/KG        11.6                   FUEL CONSUMPTION         L/100KM               9.88     (   9.75)
  TEMPERATURE    DEG C       24.4                   HYDROCARBONS (THC)       G/KM                   .11     (    .11)
                                                    CARBON MONOXIDE          G/KM                   .27     (    .27)
                                                    OXIDES OF NITROGEN       G/KM                  1.28     (  1.28)
                                                    PARTICULATES             G/KM                  .056     (  .056)
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                              HFET   VEHICLE EMISSIONS RESULTS
                                        PROJECT 05-4874-001

TEST NO.   3B2H36   RUN   1                 VEHICLE NO.3B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U CAT            DATE    9/23/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                DIESEL    EM-469-F
TRANSMISSION M5                             DYNO NO.      2                ODOMETER  8974. KM( 5576. MILES)
                                            CVS NO.   3

BAROMETER 744.22 MM HG(29.30 IN HG)         DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                  ABS. HUMIDITY 10.6 GM/KG       NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                  HFET

  BLOWER DIF P MM. H2O(IN. H2O)             698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          37.8 (100.0)
  BLOWER REVOLUTIONS                          21008.
  TOT FLOW STD. CU. METRES(SCF)             205.5 ( 7255.)
  HC  SAMPLE METER/RANGE/PPM                8.9/11/   9.
  HC  BCKGRD METER/RANGE/PPM                6.5/ 1/   7.
  CO  SAMPLE METER/RANGE/PPM                7.4/13/   7.
  CO  BCKGRD METER/RANGE/PPM                3.3/13/   3.
  CO2 SAMPLE METER/RANGE/PCT               47.0/ 3/  .81
  CO2 BCKGRD METER/RANGE/PCT                3.8/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM               35.6/ 2/  36.
  NOX BCKGRD METER/RANGE/PPM                .5/ 2/   1.
  DILUTION FACTOR                             16.52
  HC  CONCENTRATION PPM                        3.
  CO  CONCENTRATION PPM                        4.
  CO2 CONCENTRATION PCT                        .75
  NOX CONCENTRATION PPM                       35.1
  HC  MASS GRAMS                               .33
  CO  MASS GRAMS                               .89
  CO2 MASS GRAMS                            2839.5
  NOX MASS GRAMS                              13.77
  PARTICULATE MASS GRAMS                       .68
  RUN TIME              SECONDS               765.
       DFC, WET (DRY)                       .939 ( .924)
       SCF, WET (DRY)                      1.000 ( .976)
       VOL (SCM)                             205.5
       SAM BLR (SCM)                          43.52
       KM  (MEASURED)                         16.48

  TEST NUMBER,                               3B2H36
EXCHANGE PACKAGE/MEMORY DUMP ON FILE ZZZDUMP.
  BAROMETER,            MM HG                744.2
  HUMIDITY,             G/KG                  10.6
  TEMPERATURE,          DEG C                 25.0
   CARBON DIOXIDE,       G/KM                172.3
  FUEL CONSUMPTION,     L/100KM               6.40

  HYDROCARBONS,         G/KM                   .02
  CARBON MONOXIDE,      G/KM                   .05
  OXIDES OF NITROGEN,   G/KM                   .84
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                                      NYCC   VEHICLE EMISSIONS RESULTS
                                                PROJECT 05-4874-001
TEST NO.   3D2N37    RUN   1                    VEHICLE NO.3D
VEHICLE MODEL       TC FIAT U CAT               DATE     9/23/81                 TEST WEIGHT  1361. KG( 3000. LBS)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                  ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
TRANSMISSION M5                                 DYNO NO.      2                  DIESEL     EM-469-F
                                                CVS NO.    3                     ODOMETER  8988. KM( 5585. MILES)

BAROMETER 743.97 MM HG(29.29 IN HG)             DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                      ABS. HUMIDITY 10.6 GM/KG         NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                       NYCC

  BLOWER DIF P MM. H2O(IN. H2O)                 703.6 (27.7)
  BLOWER INLET P MM. H2O(IN. H2O)               576.6 (22.7)
  BLOWER INLET TEMP. DEG. C(DEG. F)              35.6 ( 96.0)
  BLOWER REVOLUTIONS                               16379.
  TOT FLOW STD. CU. METRES(SCF)                 160.7 ( 5674.)
  HC  SAMPLE METER/RANGE/PPM                     9.4/11/   9.
  HC  BCKGRD METER/RANGE/PPM                     5.6/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                     7.3/13/   7.
  CO  BCKGRD METER/RANGE/PPM                     1.8/13/   2.
  CO2 SAMPLE METER/RANGE/PCT                    20.2/ 3/  .33
  CO2 BCKGRD METER/RANGE/PCT                     3.1/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                    12.1/ 2/  12.
  NOX BCKGRD METER/RANGE/PPM                      .5/ 2/   1.
  DILUTION FACTOR                                  41.03
  HC  CONCENTRATION PPM                              4.
  CO  CONCENTRATION PPM                              5.
  CO2 CONCENTRATION PCT                             .28
  NOX CONCENTRATION PPM                            11.6
  HC  MASS GRAMS                                    .36
  CO  MASS GRAMS                                    .91
  CO2 MASS GRAMS                                  820.0
  NOX MASS GRAMS                                   3.56
  PARTICULATE MASS GRAMS                            .19
  RUN TIME              SECONDS                   597.
        DFC, WET (DRY)                          .976 ( .959)
        SCF, WET (DRY)                         1.000 ( .980)
        VOL (SCM)                                 160.7
        SAM BLR (SCM)                             34.13
        KM  (MEASURED)                             1.92

  TEST NUMBER,                                  3D2N37
  BAROMETER,             MM HG                   744.0
  HUMIDITY,              G/KG                     10.6
  TEMPERATURE,           DEG C                    25.0
   CARBON DIOXIDE,        G/KM                   426.4
  FUEL CONSUMPTION,      L/100KM                 15.88

  HYDROCARBONS,          G/KM                      .19
  CARBON MONOXIDE,       G/KM                      .47
  OXIDES OF NITROGEN,    G/KM                     1.85
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                                         85 KPH VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.   3B2S38   RUN   1                 VEHICLE NO.3B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U-CAT            DATE     9/23/81               ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                ODOMETER  8990. KM( 5586. MILES)
                                            CVS NO.   3

BAROMETER 743.97 MM HG(29.29 IN HG)         DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                  ABS. HUMIDITY 10.6 GM/KG        NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  TEST CYCLE                                  85 K

  BLOWER DIF P MM. H2O(IN. H2O)             698.5 (27.5)
  BLOWER INLET P MM. H2O(IN. H2O)           571.5 (22.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)          38.3 (101.0)
  BLOWER REVOLUTIONS                           32940.
  TOT FLOW STD. CU. METRES(SCF)             321.6 (11357.)
  HC  SAMPLE METER/RANGE/PPM                5.9/11/   6.
  HC  BCKGRD METER/RANGE/PPM                5.8/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                4.0/13/   4.
  CO  BCKGRD METER/RANGE/PPM                1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT               49.1/ 3/  .85
  CO2 BCKGRD METER/RANGE/PCT                3.4/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM               39.7/ 2/  40.
  NOX BCKGRD METER/RANGE/PPM                .5/ 2/   1.
  DILUTION FACTOR                             15.75
  HC  CONCENTRATION PPM                          1.
  CO  CONCENTRATION PPM                          2.
  CO2 CONCENTRATION PCT                         .80
  NOX CONCENTRATION PPM                       39.2
  HC  MASS GRAMS                                .09
  CO  MASS GRAMS                                .93
  CO2 MASS GRAMS                            4717.1
  NOX MASS GRAMS                              24.08
  PARTICULATE MASS GRAMS                       1.34
  RUN TIME                 SECONDS           1200.
      DFC, WET (DRY)                        .937 ( .921)
      SCF, WET (DRY)                       1.000 ( .975)
      VOL (SCM)                              321.6
      SAM BLR (SCM)                           68.31
      KM  (MEASURED)                          28.40

  TEST NUMBER,                               3B2S38
  BAROMETER,               MM HG              744.0
  HUMIDITY,                G/KG                10.6
  TEMPERATURE,             DEG C               25.0
   CARBON DIOXIDE,          G/KM              166.1
  FUEL CONSUMPTION,        L/100KM             6.17

  HYDROCARBONS,            G/KM                 .00
  CARBON MONOXIDE,         G/KM                 .03
  OXIDES OF NITROGEN,      G/KM                 .85
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                                        FTP    VEHICLE EMISSIONS RESULTS
                                                 PROJECT 05-4074-001

TEST NO.    3B2F39   RUN   2                 VEHICLE NO.3B                     TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT U-CAT            DATE     9/24/81                  ACTUAL ROAD LOAD    8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                   BAG CART NO. 1 / CVS NO.  3       DIESEL     EM-469-F
TRANSMISSION M5                              DYNO NO.      2                   ODOMETER  9022. KM( 5606. MILES)

BAROMETER 745.24 MM HG(29.34 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY  59. PCT                   ABS. HUMIDITY 11.6 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  BAG NUMBER                                      1               2               3               4
  DESCRIPTION                              COLD TRANSIENT     STABILIZED     HOT TRANSIENT     STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             723.9 (28.5)     723.9 (28.5)     723.9 (28.5)     723.9 (28.5)
  BLOWER INLET P MM. H2O(IN. H2O)           584.2 (23.0)     584.2 (23.0)     584.2 (23.0)     584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          36.1 ( 97.0)     36.1 ( 97.0)     36.7 ( 98.0)     37.8 (100.0)
  BLOWER REVOLUTIONS                          13847.           23786.           13963.           23769.
  TOT FLOW STD. CU. METRES(SCF)             135.7 ( 4792.)   233.1 ( 8232.)   136.6 ( 4823.)   232.2 ( 8199.)
  HC  SAMPLE METER/RANGE/PPM                24.2/11/  24.    11.1/11/  11.    10.5/11/  11.     9.3/11/   9.
  HC  BCKGRD METER/RANGE/PPM                 6.1/ 1/   6.     6.6/ 1/   7.     6.6/ 1/   7.     5.6/ 1/   6.
  CO  SAMPLE METER/RANGE/PPM                30.4/13/  28.     8.2/13/   7.     8.0/13/   7.     5.5/13/   5.
  CO  BCKGRD METER/RANGE/PPM                 4.2/13/   4.     3.5/13/   3.     1.7/13/   2.     1.2/13/   1.
  CO2 SAMPLE METER/RANGE/PCT                39.9/ 3/  .68    28.6/ 3/  .47    35.0/ 3/  .59    28.0/ 3/  .46
  CO2 BCKGRD METER/RANGE/PCT                 3.4/ 3/  .05     3.6/ 3/  .06     3.8/ 3/  .06     3.6/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                27.6/ 2/  28.    19.8/ 2/  20.    24.4/ 2/  24.    19.1/ 2/  19.
  NOX BCKGRD METER/RANGE/PPM                  .4/ 2/   0.      .5/ 2/   1.      .6/ 2/   1.      .6/ 2/   1.
  DILUTION FACTOR                              19.68            28.35            22.81            29.03
  HC  CONCENTRATION PPM                        18.               5.               4.               4.
  CO  CONCENTRATION PPM                        24.               4.               6.               4.
  CO2 CONCENTRATION PCT                          .63              .42              .53              .41
  NOX CONCENTRATION PPM                        27.2             19.3             23.8             18.5
  HC  MASS GRAMS                                1.44              .63              .33              .52
  CO  MASS GRAMS                                3.72             1.14              .89             1.03
  CO2 MASS GRAMS                             1556.5           1782.2           1325.4           1729.9
  NOX MASS GRAMS                                7.27             8.87             6.41             8.47
  PARTICULATE MASS GRAMS                         .42              .35              .28              .33

  HC  GRAMS/KM                                   .25              .10              .06              .08
  CO  GRAMS/KM                                   .64              .19              .15              .17
  CO2 GRAMS/KM                                269.9            289.2            228.2            280.4
  NOX GRAMS/KM                                  1.26             1.44             1.10             1.37
  FUEL CONSUMPTION BY CB L/100KM               10.09            10.76             8.49            10.43

  RUN TIME              SECONDS               505.             868.             509.             867.
  MEASURED DISTANCE     KM                      5.77             6.16             5.81             6.17
  SCF, DRY                                       .975             .977             .975             .977
      DFC, WET (DRY)                                  .959 ( .941)                     .962 ( .944)
      SCF, WET (DRY)                                 1.000 ( .976)                    1.000 ( .976)
      VOL (SCM)                                             368.8                            368.8
      SAM BLR (SCM)                                          78.39                            78.21
      KM  (MEASURED)                                         11.93                            11.98
      FUEL CONSUMPTION L/100KM                               10.44                             9.49

COMPOSITE RESULTS                                                                          3-BAG       (4-BAG)
  TEST NUMBER           3B2F39                          CARBON DIOXIDE          G/KM      268.3       ( 265.7)
  BAROMETER     MM HG   745.2                           FUEL CONSUMPTION        L/100KM     9.99      (  9.90)
  HUMIDITY      G/KG     11.6                           HYDROCARBONS (THC)      G/KM        .12       (   .12)
  TEMPERATURE   DEG C    24.4                           CARBON MONOXIDE         G/KM        .27       (   .27)
                                                        OXIDES OF NITROGEN      G/KM       1.31       (  1.29)
                                                        PARTICULATES            G/KM       .057       (  .057)
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                                    HFET   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001
TEST NO.    3B2H40    RUN   2                   VEHICLE NO.3B                        TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT U-CAT               DATE      9/24/81                    ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                      BAG CART NO.  1                      DIESEL     EM-469-F
TRANSMISSION M5                                 DYNO NO.       2                     ODOMETER  9045. KM( 5620. MILES)
                                                CVS NO.    3

BAROMETER 745.49 MM HG(29.35 IN HG)             DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                      ABS. HUMIDITY 10.6 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   TEST CYCLE                                     HFET

   BLOWER DIF P MM. H2O(IN. H2O)                718.8 (28.3)
   BLOWER INLET P MM. H2O(IN. H2O)              584.2 (23.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)             37.2 ( 99.0)
   BLOWER REVOLUTIONS                             20967.
   TOT FLOW STD. CU. METRES(SCF)                205.1 ( 7242.)
   HC   SAMPLE METER/RANGE/PPM                   7.3/11/   7.
   HC   BCKGRD METER/RANGE/PPM                   5.1/ 1/   5.
   CO   SAMPLE METER/RANGE/PPM                   4.6/13/   4.
   CO   BCKGRD METER/RANGE/PPM                    .9/13/   1.
   CO2  SAMPLE METER/RANGE/PCT                  46.2/ 3/  .79
   CO2  BCKGRD METER/RANGE/PCT                   3.1/ 3/  .05
   NOX  SAMPLE METER/RANGE/PPM                  35.2/ 2/  35.
   NOX  BCKGRD METER/RANGE/PPM                    .7/ 2/   1.
   DILUTION FACTOR                                 16.85
   HC   CONCENTRATION PPM                            3.
   CO   CONCENTRATION PPM                            3.
   CO2  CONCENTRATION PCT                           .75
   NOX  CONCENTRATION PPM                          34.5
   HC   MASS GRAMS                                  .30
   CO   MASS GRAMS                                  .78
   CO2  MASS GRAMS                               2815.2
   NOX  MASS GRAMS                                13.51
   PARTICULATE MASS GRAMS                           .65
   RUN TIME                 SECONDS                765.
        DFC, WET (DRY)                          .941 ( .925)
        SCF, WET (DRY)                         1.000 ( .976)
        VOL (SCM)                                205.1
        SAM BLR (SCM)                             43.48
        KM  (MEASURED)                            16.40

   TEST NUMBER,                                  3B2H40
   BARONETER,              MM HG                  745.5
   HUMIDITY,               G/KG                    10.6
   TEMPERATURE,            DEG C                   25.0
    CARBON DIOXIDE,         G/KM                  171.7
   FUEL CONSUMPTION,       L/100KM                 6.38

   HYDROCARBONS,           G/KM                     .02
   CARBON MONOXIDE,        G/KM                     .05
   OXIDES OF NITROGEN,     G/KM                     .82
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                                    NYCC   VEHICLE EMISSIONS RESULTS
                                             PROJECT 05-4874-001

TEST NO.   3B2N41   RUN   2                VEHICLE NO.3B                  TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL      TC FIAT U-CAT           DATE    9/24/81                ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                 BAG CART NO.  1                DIESEL     EM-469-F
TRANSMISSION M5                            DYNO NO.       2               ODOMETER  9061. KM( 5630. MILES)
                                           CVS NO.   3

BAROMETER 745.49 MM HG(29.35 IN HG)        DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY  52. PCT                 ABS. HUMIDITY 10.6 GM/KG          NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   TEST CYCLE                                 NYCC

   BLOWER DIF P MM. H2O(IN. H2O)           723.9 (28.5)
   BLOWER INLET P MM. H2O(IN. H2O)         584.2 (23.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)        35.6 ( 96.0)
   BLOWER REVOLUTIONS                        16376.
   TOT FLOW STD. CU. METRES(SCF)           160.6 ( 5672.)
   HC  SAMPLE METER/RANGE/PPM               8.5/11/   9.
   HC  BCKGRD METER/RANGE/PPM               4.9/ 1/   5.
   CO  SAMPLE METER/RANGE/PPM               5.6/13/   5.
   CO  BCKGRD METER/RANGE/PPM                .7/13/   1.
   CO2 SAMPLE METER/RANGE/PCT              20.0/ 3/  .32
   CO2 BCKGRD METER/RANGE/PCT               3.0/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM              11.6/ 2/  12.
   NOX BCKGRD METER/RANGE/PPM                .6/ 2/   1.
   DILUTION FACTOR                             41.49
   HC  CONCENTRATION PPM                          4.
   CO  CONCENTRATION PPM                          4.
   CO2 CONCENTRATION PCT                         .28
   NOX CONCENTRATION PPM                       11.0
   HC  MASS GRAMS                                .35
   CO  MASS GRAMS                                .81
   CO2 MASS GRAMS                             814.1
   NOX MASS GRAMS                              3.37
   PARTICULATE MASS GRAMS                        .21
   RUN TIME              SECONDS              598.
         DFC, WET (DRY)                    .976 ( .959)
         SCF, WET (DRY)                   1.000 ( .980)
         VOL (SCM)                           160.6
         SAM DLR (SCM)                        34.03
         KM  (MEASURED)                        1.90

   TEST NUMBER,                              3B2N41
   BAROMETER,            MM HG                745.5
   HUMIDITY,             G/KG                  10.6
   TEMPERATURE,          DEG C                 25.0
    CARBON DIOXIDE,       G/KM                427.4
   FUEL CONSUMPTION,     L/100KM              15.92

   HYDROCARBONS,         G/KM                   .18
   CARBON MONOXIDE,      G/KM                   .42
   OXIDES OF NITROGEN,   G/KM                  1.77
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                                        85KPH  VEHICLE EMISSIONS RESULTS
                                              PROJECT 05-4874-001

TEST NO.   3B2S42   RUN   2                 VEHICLE NO.3B                       TEST WEIGHT  1361. KG( 3000. LBS)
VEHICLE MODEL       TC FIAT U-CAT           DATE    9/24/81                     ACTUAL ROAD LOAD   8.2 KW( 11.0 HP)
ENGINE 2.0 L(122. CID) L-4                  BAG CART NO.  1                     DIESEL     EM-469-F
TRANSMISSION M5                             DYNO NO.      2                     ODOMETER  9062. KM( 5631. MILES)
                                            CVS NO.   3

BAROMETER 745.24 MM HG(29.34 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY  50. PCT                  ABS. HUMIDITY 10.4 GM/KG            NOX HUMIDITY CORRECTION FACTOR   .99
BAG RESULTS
  TEST CYCLE                                       85KP

  BLOWER DIF P MM. H2O(IN. H2O)               718.8 (28.3)
  BLOWER INLET P MM. H2O(IN. H2O)             584.2 (23.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)            37.8 (100.0)
  BLOWER REVOLUTIONS                             32898.
  TOT FLOW STD. CU. METRES(SCF)               321.3 (11346.)
  HC  SAMPLE METER/RANGE/PPM                   5.6/11/   6.
  HC  BCKGRD METER/RANGE/PPM                   4.9/ 1/   5.
  CO  SAMPLE METER/RANGE/PPM                   2.7/13/   2.
  CO  BCKGRD METER/RANGE/PPM                    .4/13/   0.
  CO2 SAMPLE METER/RANGE/PCT                  48.9/ 3/  .85
  CO2 BCKGRD METER/RANGE/PCT                   3.3/ 3/  .05
  NOX SAMPLE METER/RANGE/PPM                  38.5/ 2/  39.
  NOX BCKGRD METER/RANGE/PPM                    .4/ 2/   0.
  DILUTION FACTOR                                15.83
  HC  CONCENTRATION PPM                             1.
  CO  CONCENTRATION PPM                             2.
  CO2 CONCENTRATION PCT                           .80
  NOX CONCENTRATION PPM                          38.1
  HC  MASS GRAMS                                   .19
  CO  MASS GRAMS                                   .76
  CO2 MASS GRAMS                               4698.3
  NOX MASS GRAMS                                 23.18
  PARTICULATE MASS GRAMS                          1.34
  RUN TIME            SECONDS                  1200.
      DFC, WET (DRY)                          .937 ( .922)
      SCF, WET (DRY)                         1.000 ( .976)
      VOL (SCM)                                321.3
      SAM BLR (SCM)                             68.06
      KM  (MEASURED)                            28.37

  TEST NUMBER,                                3B2S42
  BAROMETER,          MM HG                    745.2
  HUMIDITY,           G/KG                      10.4
  TEMPERATURE,        DEG C                     25.6
   CARBON DIOXIDE,     G/KM                     165.6
  FUEL CONSUMPTION,   L/100KM                   6.15

  HYDROCARBONS,       G/KM                       .01
  CARBON MONOXIDE,    G/KM                       .03
  OXIDES OF NITROGEN, G/KM                       .82
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APPENDIX G

TEST RESULTS,
INDIVIDUAL HYDROCARBONS
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE G-1. INDIVIDUAL HC RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No.	1A329F				1A329H	1A329N	1A329S
Test Type	Cold FTP		Hot FTP		HFET	NYCC	85 kph
Run No.	4	5	4	5	5	5	6
Date (1981)	1/26	1/30	1/26	1/30	1/26	1/26	1/30
Measurement:							
Methane, mg/km	7.5	7.0	6.4	0.81	2.8	35.	0
Ethylene, mg/km	37.	34.	34.	33.	14.	68.	8.6
Ethane, mg/km	0	0.49	0	0.09	0	0	0
Acetylene, mg/km	5.7	5.5	4.7	4.1	1.2	14.	1.3
Propane, mg/km	4.9	0	2.6	0	0.82	0	0
Propylene, mg/km	11.	9.8	12.	9.5	0.86	29.	2.1
Benzene, mg/km	3.8	3.6	3.0	0	0.80	11.	0.66
"Total" IHC, mg/km[a]	70.	60.	63.	48.	20.	157.	13.
FID "Total HC", mg/km[b]	--	--	--	--	--	--	--

[a] toluene was analyzed for, but not found

[b] data not acceptable

TABLE G-2. INDIVIDUAL HC RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code	1A2F25	1A2F29	1A2F25	1A2F29	1A2H26	1A2N27	1A2S28
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	NYCC	85 kph
Run No.	1	2	1	2	1	1	1
Date(1981)	2/16	2/18	2/16	2/18	2/16	2/16	2/16
Measurement:							
Methane, mg/km	18.	11.	16.	6.5	5.9	43.	6.6
Ethylene, mg/km	40.	41.	37.	38.	13.	75.	0
Ethane, mg/km	1.5	0.54	1.5	0	0.61	3.4	0.27
Acetylene, mg/km	7.7	7.9	6.2	5.9	2.2	12.	0
Propane, mg/km	2.9	0	0	0	0	0	0
Propylene, mg/km	13.	12.	12.	11.	3.8	20.	0
Benzene, mg/km	3.0	4.5	1.8	1.4	1.1	0	0
"Total" IHC, mg/km[a]	86.	77.	75.	63.	27.	153.	6.8
FID "Total HC", mg/km	417.	380.	361.	416.	140.	700.	130.

[a] Toluene was analyzed for, but not found

TABLE G-3. INDIVIDUAL HC RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL WITH CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code Test Type Run No. Date (1981)	1B1F46 C-FTP 1 4/6	1B1F54 C-FTP 3 4/9	1B1F46 H-FTP 1 4/6	1B1F54 H-FTP 3 4/9	1B1H47 HFET 1 4/6	1B1H55 HFET 3 4/9	1B1N48 NYCC 1 4/6	1B1N56 NYCC 3 4/9	1B1S49 85 kph 1 4/6	1B1S57 85 kph 3 4/9
Measurement:										
Methane, mg/km	14.	11.	9.4	8.7	3.7	3.4	33.	22.	2.3	1.8
Ethylene, mg/km	18.	4.9	10.	9.0	2.2	1.6	9.6	7.5	0	0
Ethane, mg/km	1.4	2.3	2.4	0.78	0.71	0.78	5.4	4.3	0	0.56
Propylene, mg/km	2.2	0	0	0	0	0	0	0	0	0
Benzene, mg/km	1.2	0.54	0.51	0	0	0	0	0	0	0
"Total" IHC, mg/km[a]	37.	19.	22.	18.	6.6	5.8	48.	34.	2.3	2.4
FID "Total HC", mg/km	50.	62.	29.	44.	10.	10.	40.	20.	4.	10.

[a] Acetylene, propane, and toluene were analyzed for, but not found

TABLE G-4. INDIVIDUAL HC RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL WITH CATALYTIC TRAP, EM-469-F FUEL

Test Code Test Type Run No. Date (1981)	1B2F64 C-FTP 1 4/15	1B2F68 C-FTP 2 4/16	1B2F64 H-FTP 1 4/15	1B2F68 H-FTP 2 4/16	1B2H65 HFET 1 4/15	1B2H69 HFET 2 4/16	1B2N66 NYCC 1 4/15	1B2N70 NYCC 2 4/16	1B2S67 85 khp 1 4/15	1B2S71 85 khp 2 4/16
Measurement:										
Methane, mg/km	6.5	8.5	6.4	8.2	2.5	2.3	22.	22.	1.1	0.73
Ethylene, mg/km	18.	18.	12.	15.	2.7	4.3	14.	16.	0	0
Ethane, mg/km	0.78	2.2	0.77	0.78	0	0.88	0	0	0	0
Acetylene, mg/km	1.4	0	0	0	0	0	0	0	0	0
Propane, mg/km	0	2.3	0	7.2	0	3.5	0	14.	0	0.34
"Total" IHC, mg/km[a]	27.	31.	19.	31.	5.2	11.	36.	52.	1.1	1.1
FID "Total HC", mg/km	53.	53.	49.	49.	20.	20.	30.	50.	--[b]	--[b]

[a] Propylene, benzene, and toluene were analyzed for, but not found

[b] less than 5 mg/km

TABLE G-5. INDIVIDUAL HC RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-329-F BASE FUEL

Test Code Test Type Run No. Date (1981)	2A1F01 C-FTP 1 5/21	2A1F05 C-FTP 2 5/22	2A1F01 H-FTP 1 5/21	2A1F05 H-FTP 2 5/22	2A1H02 HFET 1 5/21	2A1N03 NYCC 1 5/21	2A1S04 85 kph 1 5/21
Measurement:							
Methane, mg/km	2.2	0.61	0.96	0.52	0.27	0	0.14
Ethylene, mg/km	13.	15.	14.	14.	9.8	31.1	8.8
Ethane, mg/km	0.25	0.05	0	0	0.19	0	0.11
Acetylene, mg/km	3.0	1.5	1.2	1.2	1.7	0	1.8
Propane, mg/km	0	0	0.57	0	0	0	0
Propylene, mg/km	4.9	3.2	2.7	6.4	4.1	7.5	3.8
Benzene, mg/km	1.5	0.49	0	0	0.88	0	1.3
"Total" IHC, mg/km[a]	25.	21.	19.	22.	17.	39.	16.
FID "Total HC", mg/km	121.	114.	137.	131.	80.	320.	70.

[a] Toluene was analyzed for, but not found

TABLE G-6. INDIVIDUAL HC RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-469-F FUEL

Test Code Test Type Run No. Date (1981)	2A2F26 C-FTP 3 6/19	2A2F30 C-FTP 4 6/22	2A2F26 H-FTP 3 6/19	2A2F30 H-FTP 4 6/22	2A2H27 HFET 3 6/19	2A2N28 NYCC 3 6/19	2A2S29 85 kph 3 6/19
Measurement:							
Methane, mg/km	1.4	1.7	0.28	0.76	0	0	0
Ethylene, mg/km	18.	18.	16.	17.	11.	37.	9.0
Ethane, mg/km	1.9	0.58	1.5	0	0.54	0	0
Acetylene, mg/km	3.5	1.3	0	1.2	1.8	0	1.6
Propylene, mg/km	0	3.3	0	0	3.0	0	2.8
Benzene, mg/km	0	1.3	0	0	0	0	0
"Total" IHC, mg/km[a]	25.	26.	18.	19.	16.	37.	13.
FID "Total HC", mg/km	151.	117.	156.	159.	100.	320.	80.

[a] Propane and toluene were analyzed for, but not found

TABLE G-7. INDIVIDUAL HC RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	3A1F09 C-FTP 3 7/2	3A1F13 C-FTP 4 7/6	3A1F09 H-FTP 3 7/2	3A1F13 H-FTP 4 7/6	3A1H10 HFET 3 7/2	3A1N11 NYCC 3 7/2	3A1S12 85 kph 3 7/2
Measurement:							
Methane, mg/km	7.8	15.	3.1	1.8	1.2	14.	0.49
Ethylene, mg/km	29.	35.	21.	22.	6.1	64.	4.2
Ethane, mg/km	1.4	1.2	0.24	0.07	0.03	0.63	0.03
Acetylene, mg/km	6.3	7.8	3.7	4.0	1.3	10.	0
Propane, mg/km	0	1.1	0	0	0	0	0
Propylene, mg/km	9.9	12.	6.2	9.6	1.5	23.	0
Benzene, mg/km	2.2	5.5	0	0	0	8.4	0
"Total" IHC, mg/km[a]	57.	78.	34.	37.	10.	120.	4.7
FID "Total HC", mg/km	287.	266.	237.	217.	70.	690.	50.

[a] toluene analyzed for, but not found

TABLE G-8. INDIVIDUAL HC RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No. Test Type Run No. Date (1981)	3A2F20 C-FTP 1 7/9	3A2F24 C-FTP 2 7/10	3A2F20 H-FTP 1 7/9	3A2F24 H-FTP 2 7/10	3A2H21 HFET 1 7/9	3A2N22 NYCC 1 7/9	3A2S23 85 kph 1 7/9
Measurement:							
Methane, mg/km	16.	13.	--[a]	1.9	0.11	7.2	0
Ethylene, mg/km	36.	37.	--	25.	5.3	61.	4.6
Ethane, mg/km	2.1	1.2	--	0.45	0	0	0
Acetylene, mg/km	5.9	8.2	--	5.5	0	0	0
Propane, mg/km	0	0.56	--	0	0	0	0
Propylene, mg/km	5.2	16.	--	13.	0	0	0
Benzene, mg/km	3.7	5.4	--	1.0	0	0	0
Toluene, mg/km	0	1.0	--	0	0	0	0
"Total" IHC, mg/km	69.	82.	—	47.	5.4	68.	4.6
FID "Total HC", mg/km	375.	359.	263.	263.	70.	800.	60.

[a] data not acceptable

TABLE G-9. INDIVIDUAL HC RESULTS FOR TURBOCHARGED FIAT DIESEL WITH CATALYTIC TRAP, EM-329-F FUEL

Test Code Test Type Run No. Date (1981)	3B1F01 C-FTP 1 9/17	3B1F05 C-FTP 2 9/18	3B1F01 H-FTP 1 9/17	3B1F05 H-FTP 2 9/18	3B1H02 HFET 1 9/17	3B1N03 NYCC 1 9/17	3B1S04 85 kph 1 9/17
Measurement:							
Methane, mg/km	7.1	5.8	2.1	0	0.50	9.9	0.29
Ethylene, mg/km	17.	16.	8.8	7.8	1.9	23.	0.67
Ethane, mg/km	0.78	1.8	0	0.39	0	3.2	0
Acetylene, mg/km	2.0	2.4	0	0	0	0	0
Propylene, mg/km	2.9	2.8	0	0	0	0	0
Benzene, mg/km	1.9	1.4	0	0	0	0	0
"Total" IHC, mg/km[a]	32.	30.	11.	8.2	2.4	36.	0.96
FID "Total HC", mg/km	107.	90.	46.	56.	10.	120.	--[b]

[a] Propane and toluene were analyzed for, but not found

[b] Less than 5 mg/km

TABLE G-10. INDIVIDUAL HC RESULTS FOR TURBOCHARGED FIAT DIESEL WITH CATALYTIC TRAP, EM-469-F FUEL

Test Code Test Type Run No. Date (1981)	3B2F35 C-FTP 1 9/23	3B2F39 C-FTP 2 9/24	3B2F35 H-FTP 1 9/23	3B2F39 H-FTP 2 9/24	3B2H36 HFET 1 9/23	3B2N37 NYCC 1 9/23	3B2S38 85 kph 1 9/23
Measurement:							
Methane, mg/km	10.	12.	1.9	2.3	0	2.6	0
Ethylene, mg/km	22.	23.	8.3	9.1	1.5	23.	0
Ethane, mg/km	1.0	1.2	0.06	0.44	0	0.62	0
Acetylene, mg/km	3.3	3.4	0	0	0	0	0
Propane, mg/km	0	0.6	0	0	11.8	55.	4.3
Propylene, mg/km	4.8	4.3	0	0	0	0	0
Benzene, mg/km	3.2	2.9	0	0	0	0	0
"Total" IHC, mg/km	44.	47.	10.	12.	13.	81.	4.3
FID "Total HC", mg/km	159.	165.	61.	71.	20.	190.	--[b]

[a] Toluene analyzed for, but not found

[b] Less than 5 mg/km

APPENDIX H

TEST RESULTS,
ALDEHYDES AND KETONES
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE H-1. ALDEHYDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No.	1A329F				1A329H		1A329N		1A329S	
Test Type	Cold FTP		Hot FTP		HFET		NYCC		85 kph	
Run No.	4	5	4	5	5	6	5	6	5	6
Date (1981)	1/26	1/30	1/26	1/30	1/26	1/30	1/26	1/30	1/26	1/30
Formaldehyde, mg/km	0	16.	0	13.	1.8	6.9	0	26.	0 0	3.0
Acetaldehyde, mg/km	0	6.7	0	6.4	2.5	3.6	47.	7.9	1.6	2.5
Acetone,[a] mg/km	0	0	0	3.4	0	0	0	0	0	3.3
Isobutyraldehyde, mg/km	0	0	0	0	0	0	18.	0	0	0
Methylethylketone, mg/km	0	0	0	0.2	0	0	C	0	0	0
"Total"[b] aldehydes, mg/km	0	23.	0	23.	4.3	10.	47.	34.	1.6	8.8

[a] includes propanal and acrolein
[b] does not include isobutyraldehyde

TABLE H-2. ALDEHYDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No.	1A2F25[c]	1A2F29	1A2F33	1A2F25	1A2F29	1A2F33	1A2H26	1A2H30	1A2N27	1A2N31	1A2S28	1A2S32
Test Type	C-FTP	C-FTP	C-FTP	H-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	3	1	2	3	1	2	1	2	1	2
Date (1981)	2/16	2/18	3/11	2/16	2/18	3/11	2/16	2/18	2/16	2/18	2/16	2/18
Formaldehyde, mg/km		6.9	8.6	18.	7.2	10.	1.2	2.1	20.	17.5	2.8	1.3
Acetaldehyde, mg/km		0	0.7	3.9	0	1.1	0	0	3.3	7.2	0.23	0
Acetone,[a] mg/km		0	0	0	0	0	0	0	0	0	2.3	0
Isobutyraldehyde, mg/km		4.7	17.	7.6	0	26.	20.	20.	220.	165.	0	7.4
"Total"[b] aldehydes, mg/km		6.9	9.3	22.	7.2	11.	1.2	2.1	23.	25.	5.3	1.3

[a] includes propanal and acrolein
[b] does not include isobutyraldehyde
[c] test voided due to sampling pump failure

TABLE H-3. ALDEHYDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL WITH CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code No.	1B1F46	1B1F54	1B1F46	1B1F54	1B1H47	1B1H55	1B1N48	1B1N56	1B1S49	1B1S57
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	3	1	3	1	3	1	3	1	3
Date (1981)	4/6	4/9	4/6	4/9	4/6	4/9	4/6	4/9	4/6	4/9
Formaldehyde, mg/km	0.90	2.5	0.10	1.4	0	0	0	0	0	0
Isobutyraldehyde, mg/km	0	1.9	7.9	1.6	0	2.7	72.	59.	1.3	0.24
"Total"[a] aldehydes, mg/km	0.90	2.5	0.10	1.4	0	0	0	0	0	0

[a] does not include isobutyraldehyde

TABLE H-4. ALDEHYDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL WITH CATALYTIC TRAP, EM-469-F FUEL

Test Code No.	1B2F64	1B2F68	1B2F64	1B2H68	1B2H65	1B2H69	1B2N66	1B2N70	1B2S67	1B2S71
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	4/15	4/16	4/15	4/16	4/15	4/16	4/15	4/16	4/15	4/16
Formaldehyde, mg/km	2.9	2.0	2.0	0.78	0	1.5	0	0	0	0
Isobutyraldehyde, mg/km	1.4	0	8.5	1.2	15.	0	32.	65.	2.3	3.6
"Total"[a] aldehydes, mg/km	2.9	2.0	2.0	0.78	0	1.5	0	0	0	0

[a] does not include isobutyraldehyde

TABLE H-5. ALDEHYDE RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-329-F BASE FUEL

Test Code No.	2A1F01	2A1F05	2A1F01	2A1F05	2A1H02	2A1H06	2A1N03	2A1N07	2A1S04	2A1S08
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	5/21	5/22	5/21	5/22	5/21	5/22	5/21	5/22	5/21	5/22
Formaldehyde, mg/km	2.0	0	2.5	0	0	0	0	0	0	0
Isobutyraldehyde, mg/km	20.	7.4	9.8	13.	8.1	20.	90.	164.	5.1	18.
"Total" Aldehydes, mg/km^a	2.0	0	2.5	0	0	0	0	0	0	0

^{a}does not include isobutyraldehyde

TABLE H-6. ALDEHYDE RESULTS FOR 1981 OLDSMOBILE CUTALSS DIESEL WITH EM-469-F FUEL

Test Code No.	2A2F26	2A2F30	2A2F26	2A2F30	2A2H27	2A2H31	2A2N28	2A2N32	2A2S29	2A2S33
Test Type	C=FTP	C=FTP	H=FTP	H=FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	3	4	3	4	3	4	3	4	3	4
Date (1981)	6/19	6/22	6/19	6/22	6/19	6/22	6/19	6/22	6/19	6/22
Formaldehyde, mg/km	0	2.2	0	0	0	0	0	0	0	0
Isobutyraldehyde, mg/km	0	0	0	5.4	0	4.2	36.	0	0	0
"Total" Aldehydes, mg/km^a	0	2.2	0	0	0	0	0	0	0	0

^{a}does not include isobutyraldehyde

TABLE H-7. ALDEHYDE RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	3A1F09 C-FTP 3 7/2	3A1F13 C-FTP 4 7/6	3A1F09 H-FTP 3 7/2	3A1F13 H-FTP 4 7/6	3A1H10 HFET 3 7/2	3A1H14 HFET 4 7/6	3A1N11 NYCC 3 7/2	3A1N15 NYCC 4 7/6	3A1S12 85 kph 3 7/2	3A1S16 85 kph 4 7/6
Formaldehyde, mg/km	1.1	3.2	1.3	2.2	0	1.1	0	11.5	0	0.62
Acetaldehyde, mg/km	0	3.9	0	4.3	1.6	0	0	0	2.1	0.44
Acetone[a], mg/km	0	5.5	0	8.4	0	0	0	0	0	3.0
Methylethylketone, mg/km	0	0	5.0	0	0	0	0	0	0	0
"Total"[a]aldehydes, mg/km	1.1	13.	6.3	15.	1.6	1.1	0	12.	2.1	4.1

[a] includes propanal and acrolein

TABLE H-8. ALDEHYDE RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No. Test Type Run No. Date (1981)	3A2F20 C-FTP 1 7/9	3A2F24 C-FTP 2 7/10	3A2F20 H-FTP 1 7/9	3A2F24 H-FTP 2 7/10	3A2H21 HFET 1 7/9	3A2H25 HFET 2 7/10	3A2N22 NYCC 1 7/9	3A2N26 NYCC 2 7/10	3A2S23 85 kph 1 7/9	3A2S27 85 kph 2 7/10
Formaldehyde, mg/km	4.3	6.3	9.0	1.5	0.19	0	17.9	0	0	0
Isobutyraldehyde, mg/km	0	9.0	0	0	0	0	0	0	0	0
Benzaldehyde, mg/km	0	0	2.7	0	3.4	0	6.4	0	0	0
"Total"[a] aldehydes, mg/km	4.3	6.3	9.0	1.5	0.19	0	18.	0	0	0

[a] does not include isobutyraldehyde and benzaldehyde

TABLE H-9. ALDEHYDE RESULTS FOR TURBOCHARGED FIAT DIESEL WITH CATALYTIC TRAP, EM-329-F FUEL

Test Code	3B1F01	3B1F05	3B1F01	3B1F05	3B1H02	3B1H06	3B1N03	3B1N07	3B1S04	3B1S08
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	9/17	9/18	9/17	9/18	9/17	9/18	9/17	9/18	9/17	9/18
Formaldehyde, mg/km	0	0	0	0	0	0	6.8	0	0	0
Methylethylketone, mg/km	0	0	0	0	0	0	33.	0	0	0
Benzaldehyde, mg/km	0	1.5	1.5	0	0	1.2	7.5	10.8	0.89	0.62
"Total"[a] aldehydes, mg/km	0	0	0	0	0	0	40	0	0	0

[a] does not include benzaldehyde

TABLE H-10. ALDEHYDE RESULTS FOR TURBOCHARGED FIAT DIESEL WITH CATALYTIC TRAP, EM-469-F FUEL

Test Code	3B2F35	3B2F39	3B2F35	3B2F39	3B2H36	3B2H40	3B2N37	3B2N41	3B2S38	3B2S42
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24
Formaldehyde, mg/km	0	1.1	0	0	0	0	0	0	0	0
Isobutyraldehyde, mg/km	0	24.	0	4.9	8.3	0	0	210.	9.9	0
Methylethylketone, mg/km	0	0	0	0	0	0.97	25.	0	0	1.4
Benzaldehyde, mg/km	0	0	0	0	0	1.2	0	0	0	0.33
"Total"[a] aldehydes, mg/km	0	1.1	0	0	0	0.97	25.	0	0	1.4

[a] does not include isobutyraldehyde and benzaldehyde

SOUTHWEST RESEARCH INSTITUTE

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May 13, 1981

Mr. Frank M. Black
Mobile Source Emissions Research Branch
Environmental Protection Agency
Mail Drop 46 FTP
Research Triangle Park, N.C. 27711

Dear Frank:

Please find two sample vials, Samples A and B, enclosed. These are the two NYCC samples discussed in our phone conversations which supposedly contain large amounts of isobutyraldehyde - DNPH derivative. I hope that these samples are suitable for the HPLC and mass spectral confirmational analyses that we discussed in our phone conversation.

These samples were run using our GC system and found to contain 0.38 (A) and 0.33 (B) mg of isobutyraldehyde - DNPH derivative. Other aldehydes derivatives found in the initial analyses included formaldehyde (~0.07 mg) and acetaldehyde (<0.01 mg). The two samples were taken to dryness in a vacuum oven (70°C, 27 inches of mercury vacuum). To determine if the drying procedure altered the sample integrity, sample A was rerun on the GC system. Two (2) ml of toluene was added to the sample, followed by a routine analysis. The second analysis gave <0.01 mg formaldehyde-DNPH derivative and 0.39 mg isobutyraldehyde derivative, indicating a loss of formaldehyde derivative and essentially no change for the isobutyraldehyde derivative. After analysis, the sample was returned to dryness using the above conditions. Both samples contain 0.1 mg of anthracene as an internal standard.

If I can provide you with any other information, please call me at 512-684-5111 ext. 2977.

Sincerely,

Lawrence R. Smith

Lawrence R. Smith
Senior Research Scientist
Department of Emissions Research

LRS:kh

APPENDIX I

TEST RESULTS,
PHENOLS
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE I-1. PHENOL RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No.	1A329F		1A329F		1A329F		1A329F	
Test Type	C-FTP	C-FTP	C-FTP	C-FTP	H-FTP	H-FTP	H-FTP	H-FTP
Run No.	4	5	4	5	4	5	4	5
Filtered	No	No	Yes	Yes	No	No	Yes	Yes
Date (1981)	1/26	1/30	1/26	1/30	1/26	1/30	1/26	1/30
Phenol, mg/km	0	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0	0	0	0	0
m-, p-cresol, mg/km	0	0.47	0.32	0	0	3.1	0	3.1
Group Five,[a] mg/km	0.75	2.2	0.39	1.2	1.5	1.1	0.63	0.53
2-n-propylphenol, mg/km	0	0.49	0	0	0	0.12	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0	0	0.29	0.22	0
2,3,5,6-tetramethylphenol, mg/km	2.5	9.0	7.7	14.	5.8	5.7	4.1	1.3
"Total" Phenols, mg/km	3.2	12.	8.4	15.	7.3	10.	5.0	4.9

Test Code No.	1A329H		1A329N		1A329S	
Test Type	HFET		NYCC		85 kph	
Run No.	5		5		5	
Filtered	No	Yes	No	Yes	No	Yes
Date (1981)	1/26	1/26	1/26	1/26	1/26	1/26
Phenol, mg/km	0	0	0	0	0	0
Salicylaldehyde, mg/km	0.31	0	0	0	0	0
m-, p-cresol, mg/km	1.0	0	7.9	0	0	0
Group Five,[a] mg/km	1.3	0.52	21.	5.4	0.82	0.12
2-n-propylphenol, mg/km	0.74	0	2.4	0	0	0
2,3,5,-trimethylphenol, mg/km	0	0.11	3.4	0	0.20	0
2,3,5,6-tetramethylphenol, mg/km	2.5	2.3	28.	58.	1.6	1.9
"Total" Phenols, mg/km	5.8	2.9	63.	63.	2.6	2.0

[a] Group Five includes p-ethylphenol/ 2-isopropylphenol/ 2,3-xylenol/ 3,5-xylenol/ 2,4,6-trimethylphenol

TABLE I-2. PHENOL RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No.	1A2F25	1A2F29	1A2F25	1A2F29	1A2F25	1A2F29	1A2F25	1A2F29
Test Type	C-FTP	C-FTP	C-FTP	C-FTP	H-FTP	H-FTP	H-FTP	H-FTP
Run No.	1	2	1	2	1	2	1	2
Filtered	No	No	Yes	Yes	No	No	Yes	Yes
Date (1981)	2/16	2/18	2/16	2/18	2/16	2/18	2/16	2/18
Phenol, mg/km	0	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0	0	0	0	0
m-,p-cresol, mg/km	0	0	0	0	0	0	0	0
Group Five,[a] mg/km	0	5.7	1.4	11.	1.5	0	0	6.6
2-n-propylphenol, mg/km	0	0	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0.30	13.	0.45	8.7	0	0
2,3,5,6-tetramethylphenol, mg/km	3.2	7.4	10.	14.	14.	9.4	2.0	8.6
"Total" Phenols, mg/km	3.2	13.	12.	38.	16.	18.	2.0	15.

Test Code No.	1A2H26	1A2H30	1A2H26	1A2H30	1A2N27	1A2N31	1A2N27	1A2N31	1A2S28	1A2S32	1A2S28	1A2S32
Test Type	HFET	HFET	HFET	HFET	NYCC	NYCC	NYCC	NYCC	85 kph	85 kph	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2	1	2
Filtered	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Date (1981)	2/16	2/18	2/16	2/18	2/16	2/18	2/16	2/18	2/16	2/18	2/16	2/18
Phenol, mg/km	0	0	0	0	0	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0	0	0	0	0	0	0	0.40	0
m-,p-cresol, mg/km	0	0	0	0	0	0	12.	0	0	0	0.27	0
Group Five,[a] mg/km	0.69	4.1	0	0	9.5	0	10.	0	0.25	0	0.77	2.9
2-n-propylphenol, mg/km	0	0	0	0	0	0	1.8	0	0	0	0.35	0
2,3,5-trimethylphenol, mg/km	0.83	5.0	0	6.3	5.0	0	0	0	0.12	0	0.15	3.5
2,3,5,6-tetramethylphenol, mg/km	5.2	5.3	5.9	6.7	62.	52.	55.	57.	2.2	3.0	7.4	3.8
"Total" Phenols, mg/km	6.7	14.	5.9	13.	76.	52.	79.	57.	2.6	3.0	9.3	10.

[a] Group Five includes p-ethylphenol/ 2-isopropylphenol, 2,3-xylenol/ 3,5-xylenol/ 2,4,6-trimethylphenol

TABLE I-3. PHENOL (FILTERED) RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, WITH CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	1B1F46 C-FTP 1 4/6	1B1F54 C-FTP 3 4/9	1B1F46 H-FTP 1 4/6	1B1F54 H-FTP 3 4/9	1B1H47 HFET 1 4/6	1B1H55 HFET 3 4/9
Phenol, mg/km	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0	0	0
m-, p-cresol, mg/km	0	0	0	0	0	0
Group Five,[a] mg/km	0	0	0	0	0	0
2-n-propylphenol, mg/km	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0	0.05	0
2,3,5,6-tetramethylphenol, mg/km	12.	1.3	19.	3.1	0.68	0.75
"Total" Phenols, mg/km	12.	1.3	19.	3.1	0.73	0.75

Test Code No. Test Type Run No. Date (1981)	1B1N48 NYCC 1 4/6	1B1N56 NYCC 3 4/9	1B1S49 85 kph 1 4/6	1B1S57 85 kph 3 4/9
Phenol, mg/km	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0
m-,p-cresol, mg/km	0	0	0	0
Group Five,[a] mg/km	0	0	0	0
2-n-propylphenol, mg/km	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0
2,3,5,6-tetramethylphenol, mg/km	22.	27.	17.	12.
"Total" Phenols, mg/km	22.	27.	17.	12.

[a] Group Five includes p-ethylphenol/ 2-isopropylphenol/ 2,3-xylenol/ 3,5-xylenol/ 2,4,6-trimethylphenol.

TABLE I-4. PHENOL (FILTERED) RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, WITH CATALYTIC TRAP, EM-469-F

Test Code No. Test Type Run No. Date (1981)	1B2F64 C-FTP 1 4/15	1B2F68 C-FTP 2 4/16	1B2F64 H-FTP 1 4/15	1B2F68 H-FTP 2 4/16	1B2H65 HFET 1 4/15	1B2H69 HFET 2 4/16
Phenol, mg/km	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0	0	0
m-, p-cresol, mg/km	0	0	0	0	0	0
Group Five,[a] mg/km	0	0	0	0	0	0
2-n-propylphenol, mg/km	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	1.8	0	0.20	0	0
2,3,5,6-tetramethylphenol, mg/km	74.	8.9	0.91	2.7	0.68	2.5
"Total" Phenols, mg/km	74.	11.	0.91	2.9	0.68	2.5

Test Code No. Test Type Run No. Date (1981)	1B2N66 NYCC 1 4/15	1B2N70 NYCC 2 4/16	1B2S67 85 kph 1 4/15	1B2S71 85 kph 2 4/16
Phenol, mg/km	0	0	0	0
Salicylaldehyde, mg/km	0	0	0	0
m-, p-cresol, mg/km	0	0	0	0
Group Five,[a] mg/km	0	0	0	0.59
2-n-propylphenol, mg/km	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0
2,3,5,6-tetramethylphenol, mg/km	7.1	7.9	0.30	3.7
"Total" Phenols, mg/km	7.1	7.9	0.30	4.3

[a] Group Five includes p-ethylphenol/ 2-isopropylphenol/ 2,3-xylenol/ 3,5-xylenol/ 2,4,6-trimethylphenol.

TABLE I-5. PHENOL (FILTERED) RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	2A1F01 C-FTP 1 5/21	2A1F05 C-FTP 2 5/22	2A1F01 H-FTP 1 5/21	2A1F05 H-FTP 2 5/22	2A1H02 HFET 1 5/21	2A1H06 HFET 2 5/22	2A1N03 NYCC 1 5/21	2A1N07 NYCC 2 5/22	2A1S04 85 kph 1 5/21	2A1S08 85 kph 2 5/22
Phenol, mg/km	0	0	0	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0.45	0	0	0	0.17	0	0	0	0	0
m-,p-cresol, mg/km	0	0	0	0	0	0	0	0	0	0
Group Five,[a] mg/km	0	0	0	0	0	0	0	0	0	0
2-n-propylphenol, mg/km	0.09	0	0	0	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0	0	0	0	0	0	0
2,3,5,6-tetramethylphenol, mg/km	13.	0.46	13.	6.4	0.10	0.10	40.	8.4	0.88	0.55
"Total" Phenols, mg/km	13.5	0.46	13.	6.4	0.27	0.10	40.	8.4	0.88	0.55

[a] Group Five includes p-ethylphenol/2-isopropylphenol/2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

TABLE I-6. PHENOL (FILTERED) RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-469-F FUEL

Test Code No.	2A2F26	2A2F30	2A2F26	2A2F30	2A2H27	2A2H31	2A2N28	2A2N32	2A2S29	2A2S33
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	3	4	3	4	3	4	3	4	3	4
Date (1981)	6/19	6/22	6/19	6/22	6/19	6/22	6/19	6/22	6/19	6/22
Phenol, mg/km	0	0.29	0	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	2.3	0	0	0	0	0	0	0	0	0
m-,p-cresol, mg/km	0	0	0	0	0	0	0	0	0	0
Group Five,[a] mg/km	0	0	0	0	0	0	0	0	0	0
2-n-propylphenol, mg/km	1.2	0.13	0	0	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	0	0	2.0	0	6.4	0	0.33	0
2,3,5,6-tetramethylphenol, mg/km	4.9	4.3	3.7	20.	15.	4.8	61.	63.	1.1	1.5
"Total" Phenols, mg/km	8.4	4.7	3.7	20.	17.	4.8	67.	63.	1.4	1.5

[a] Group Five includes p-ethylphenol/2-isopropylphenol/ 2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

TABLE I-7. PHENOL (FILTERED) RESULTS FOR TUROBCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No.	3A1F09	3A1F13	3A1F09	3A1F13	3A1H10	3A1H14	3A1N11	3A1N15	3A1S12	3A1S16
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	3	4	3	4	3	4[b]	3	4	3	4[b]
Date (1981)	7/2	7/6	7/2	7/6	7/2	7/6	7/2	7/6	7/2	7/6
Phenol, mg/km	0	0	0	0	0	--	0	0	0	--
Salicylaldehyde, mg/km	7.8	0	36.	0	0	--	0	0	0	--
m-,p-cresol, mg/km	0	0	0	0	0	--	0	0	0	--
Group Five[a], mg/km	0	0.43	0.61	0	0	--	3.6	0	0	--
2-n-propylphenol, mg/km	1.0	0	2.1	0	0.16	--	1.4	0	0	--
2,3,5-trimethylphenol, mg/km	0	0	1.6	0.18	0	--	6.7	0	0	--
2,3,5,6-tetramethylphenol, mg/km	0.35	24.	20.	7.0	0	--	42.	43.	0	--
"Total" Phenols, mg/km	9.2	24.	60.	7.2	0.16	--	54.	43.	0	--

[a] Group five includes p-ethylphenol/2-isopropylphenol/ 2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

[b] sample contaminated

TABLE I-8. PHENOL (FILTERED) RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No.	3A2F20	3A2F24	3A2F20	3A2F24	3A2H21	3A2H25	3A2H22	3A2N26	3A2S23	3A2S27
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1[b]	2.	1	2	1	2	1	2
Date (1981)	7/9	7/10	7/9	7/10	7/9	7/10	7/9	7/10	7/9	7/10
Phenol, mg/km	0	22.	--	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0	0	--	0	0	0	0	0	0	0
m-,p-cresol, mg/km	0	0	--	0	0	0	0	0	0	0
Group Five[a], mg/km	0	0	--	0	1.0	1.1	0	12.	0	1.2
2-n-propylphenol, mg/km	0	0	--	0	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0	--	0.15	0.55	0.31	0	0	0	0
2,3,5,6-tetramethylphenol, mg/km	6.4	0	--	4.7	4.5	7.0	47.	58.	2.6	2.2
"Total" Phenols, mg/km	6.4	22.	--	4.9	6.1	8.4	47.	70.	2.6	3.4

[a] Group five includes p-ethylphenol/2-isopropylphenol/2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

[b] sample contaminated

TABLE I-9. PHENOL (FILTERED) RESULTS FOR TURBOCHARGED FIAT DIESEL, WITH UNDERFLOOR CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code No.	3B1F01	3B1F05	3B1F01	3B1F05	3B1H02	3B1H06	3B1N03	3B1N07	3B1S04	3B1S08
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	9/17	9/18	9/17	9/18	9/17	9/18	9/17	9/18	9/17	9/18
Phenol, mg/km	0	0	0	0	--[b]	0	--	0	--	0
Salicylaldehyde, mg/km	0	6.0	0	1.7	--	0.70	--	0	--	1.3
m-,p-cresol, mg/km	0	0	0	0	--	0	--	0	--	0.14
Group Five[a], mg/km	0	0.50	0	2.0	--	1.4	--	0	--	0.72
2-n-propylphenol, mg/km	0	1.6	0	0	--	0	--	0	--	0.07
2,3,5-trimethylphenol, mg/km	0	0.90	0.26	0	--	0.36	--	0	--	0
2,3,5,6-tetramethylphenol, mg/km	0	2.2	2.1	7.1	--	21.	--	0	--	5.6
"Total" Phenols, mg/km	0	11.	2.4	11.	--	23.	--	0	--	7.8

[a] Group five includes p-ethylphenol/2-isopropylphenol/2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

[b] Samples lost through sampling difficulty

TABLE I-10. PHENOL (FILTERED) RESULTS FOR TURBOCHARGED FIAT DIESEL, WITH UNDERFLOOR CATALYTIC TRAP, EM-469-F FUEL

Test Code No.	3B2F35	3B2F39	3B2F35	3B2F39	3B2H36	3B2H40	3B2N37	3B2N41	3B2S38	3B2S42
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC	85 kph	85 kph
Run No.	1	2	1	2	1	2	1	2	1	2
Date (1981)	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24
Phenol, mg/km	0	0	3.6	0	0	0	0	0	0	0
Salicylaldehyde, mg/km	0.36	0	0.29	0	0	0	0	0	0	0
m-,p-cresol, mg/km	0	0	0	0	0	0	0	0	0	0
Group Five[a] , mg/km	1.4	3.3	0	0	0.52	0.63	5.6	1.7	0.82	0.86
2-n-propylphenol, mg/km	0	0	0.79	0	0	0	0	0	0	0
2,3,5-trimethylphenol, mg/km	0	0.21	0.57	0	0	0.19	0	0	0	0
2,3,5,6-tetramethylphenol, mg/km	23.	7.9	14.	7.6	6.7	4.0	28.	38.	2.3	4.7
"Total" Phenols, mg/km	25.	11.	19.	7.6	7.2	4.8	34.	40.	3.1	5.6

[a] Group five includes p-ethylphenol/2-isopropylphenol/ 2,3-xylenol/3,5-xylenol/2,4,6-trimethylphenol

APPENDIX J

TEST RESULTS,
PARAFFIN PEAKS
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE J-1. PARAFFIN PEAKS OF TRAP-COLLECTED GASEOUS HYDROCARBONS FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS, FUEL EM-329-F

		Percent of Peak Area														
		Fiat N.A.			Fiat N.A./Trap			Fiat T.C.			Fiat T.C./Trap			Cutlass		
Carbon Number	Fuel EM-329-F	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph
8	0.03											42.		14.	17.	23.
9	0.3															
10	1.1	2.3	17.	6.9	10.			14.	18.	14.						
11	2.4	2.3	6.1	2.9	2.5			1.7			1.7	16.	3.5		11.	6.6
12	4.1	0.2	0.6	0.5				1.0			0.5			1.5		
13																
14	5.7	7.2	5.1	5.9	1.9			4.1			6.3					
15	6.7	5.4	2.3	4.2	9.0	9.7	4.1	3.9			12.			4.3		
16	6.4	3.0	0.9	2.0				9.0			5.5					
17	6.1	3.6	1.6	2.8	0.7	14.	6.9	6.0			2.7					
18	4.2	0.9	0.1	0.8	4.2	34.	23.	2.9			0.4			4.2		
19																
20	1.7	1.7	0.3	1.5	1.8	15.										
21																
22																
23																
24	0.1	0.6	0.4	1.7	2.5	7.0	8.2	1.6	24.	5.5	1.1		70.	1.9	53.	22.
Carbon Number Total	39.	27.	34.	29.	33.	80.	42.	44.	42.	20.	30.	58.	74.	26.	81.	52.

TABLE J-2. PARAFFIN PEAKS OF TRAP-COLLECTED GASEOUS HYDROCARBONS FROM FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESEL, FUEL EM-469-F

Carbon Number	Percent of Peak Area															
	Fuel EM-329-F	Fiat N.A.			Fiat N.A./Trap			Fiat T.C.			Fiat T.C./Trap			Cutlass		
		4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph	4-bag FTP	NYCC	85 kph
8	0.05													6.6		
9	0.2															
10	0.7	7.9	18.	16.	5.5		29.	11.	12.	6.7					10.	15.
11	1.9	1.8	1.9	1.6				2.9				10.	7.3			
12	3.9	0.3	0.7					1.4			2.8		2.2	1.7	26.	
13																
14	5.0	4.9	4.0	3.5				7.2			3.3				16.	4.5
15	5.6	8.6	8.4	8.3	8.4			4.2			1.5			1.7	6.7	
16	6.2	1.0	2.0					4.7		3.6				2.5	18.	
17	6.2	2.1	3.3	1.0	8.4			8.5		4.6				2.3	7.4	
18	4.8	0.1	2.7	3.6				2.9						1.8	2.1	
19																
20	2.3	1.7	1.2	1.6	11.			2.9	65.							
21																
22																
23																
24	0.2	1.0	0.8	2.6	12.	100	7.0	5.9		19.		38.	18.	2.3		
Carbon Number Total	37.	29.	43.	38.	45.	100	36.	52.	77.	34.	7.6	48.	28.	17.	86.	20.

APPENDIX K

TEST RESULTS,
ORGANIC SULFIDES
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE K-1. ORGANIC SULFIDE RESULTS FOR NATURALLY-ASPIRATED FIAT FIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No.	1A329F			1A329H		1A329N		1A329S
Test Type	Cold FTP	Hot FTP	Comb.FTP	HFET		NYCC		85 kph
Run No.	4	4	5	5	6	5	6	6
Date (1981)	1/26	1/26	1/30	1/26	1/30	1/26	1/30	1/30
COS, mg/km	9.8	11.	7.0	12.	8.2	200.	64.	5.5
$(CH_3)_2S$, mg/km	4.6	5.2	9.8	4.9	6.4	30.	9.5	1.1
$(C_2H_5)_2S$, mg/km	0.06	0	0	0.03	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0.03	0	0	0	0

TABLE K-2. ORGANIC SULFIDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No.	1A2F25	1A2F29	1A2F25	1A2F29	1A2H26	1A2H30	1A2N27	1A2N31
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC
Run No.	1	2	1	2	1	2	1	2
Date (1981)	2/16	2/18	2/16	2/18	2/16	2/18	2/16	2/18
COS, mg/km	16.	12.	15.	20.	5.8	6.4	140.	100.
$(CH_3)_2S$, mg/km	2.2	2.5	4.3	4.0	4.3	1.3	12.	8.8
$(C_2H_5)_2S$, mg/km	0	0	0	0	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	0	0	0

TABLE K-3. ORGANIC SULFIDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, WITH CATALYTIC TRAP, EM-329-F BASE FUEL

Test Code No.	1B1F46	1B1F58	1B1F46	1B1F58	1B1H47	1B1H59	1B1N48	1B1N60
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC
Run No.	1	4	1	4	1	4	1	4
Date (1981)	4/6	4/10	4/6	4/10	4/6	4/10	4/6	4/10
COS, mg/km	37.	13.	28.	17.	1.5	8.7	206.	64.
$(CH_3)_2S$, mg/km	9.0	18.	7.9	10.	2.9	3.8	39.	35.
$(C_2H_5)_2S$, mg/km	0	0.40	0	0.03	0	0	0	0.15
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	0	0	0

TABLE K-4. ORGANIC SULFIDE RESULTS FOR NATURALLY-ASPIRATED FIAT DIESEL, WITH CATALYTIC TRAP, EM-469-F FUEL

Test Code No.	1B2F64	1B2F64	1B2F65	1B2F66
Test Type	C-FTP	H-FTP	HFET	NYCC
Run No.	1	1	1	1
Date (1981)	4/15	4/15	4/15	4/15
COS, mg/km	16.	16.	8.5	61.
$(CH_3)_2S$, mg/km	11.	3.3	5.0	32.
$(C_2H_5)_2S$, mg/km	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0

TABLE K-5. ORGANIC SULFIDE RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	2A1F05 C-FTP 2 5/22	2A1F09 C-FTP 3 5/25	2A1F05 H-FTP 2[a] 5/22	2A1F09 H-FTP 3 5/25	2A1H06 HFET 2 5/22	2A1H10 HFET 3 5/25	2A1N07 NYCC 2[a] 5/22	2A1N11 NYCC 3 5/25
COS, mg/km	35.	38.	--	30.	22.	16.	--	140.
$(CH_3)_2S$, mg/km	10.	5.1	--	4.4	9.5	1.8	--	23.
$(C_2H_5)_2S$, mg/km	0	0	--	0	0	0	--	0
$(CH_3)_2S_2$, mg/lm	0	0	--	0	0	0	--	0

[a] Sample lost

TABLE K-6. ORGANIC SULFIDE RESULTS FOR 1981 OLDSMOBILE CUTLASS DIESEL WITH EM-469-F FUEL

Test Code No. Test Type Run No. Date (1981)	2A2F26 C-FTP 3 6/19	2A2F30 C-FTP 4 6/22	2A2F26 H-FTP 3 6/19	2A2F30 H-FTP 4 6/22	2A2H27 HFET 3 6/19	2A2H31 HFET 4[a] 6/22	2A2N28 NYCC 3 6/19	2A2N32 NYCC 4 6/22
COS, mg/km	35.	107.	38.	57.	23.	--	153.	186.
$(CH_3)_2S$, mg/km	3.8	17.	4.2	12.	3.6	--	19.	33.
$(C_2H_5)_2S$, mg/km	0	0	0	0	0	--	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	--	0	0

[a] Sample lost

TABLE K-7. ORGANIC SULFIDE RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-329-F BASE FUEL

Test Code No. Test Type Run No. Date (1981)	3A1F09 C-FTP 3 7/2	3A1F13 C-FTP 4 7/6	3A1F09 H-FTP 3 7/2	3A1F13 H-FTP 4 7/6	3A1H10 HFET 3 7/2	3A1H14 HFET 4 7/6	3A1N11 NYCC 3 7/2	3A1N15 NYCC 4 7/6
COS, mg/km	32.	21.	28.	26.	20.	15.	145.	107.
$(CH_3)_2S$, mg/km	5.9	5.8	5.2	6.4	4.3	4.8	34.	35.
$(C_2H_5)_2S$, mg/km	0	0	0	0	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	0	0	0

TABLE K-8. ORGANIC SULFIDE RESULTS FOR TURBOCHARGED FIAT DIESEL, NO AFTERTREATMENT, EM-469-F FUEL

Test Code No. Test Type Run No. Date (1981)	3A2F20 C-FTP 1 7/9	3A2F24 C-FTP 2 7/10	3A2F20 H-FTP 1 7/9	3A2F24 H-FTP 2 7/10	3A2H21 HFET 1 7/9	3A2H25 HFET 2 7/10	3A2N22 NYCC 1 7/9	3A2N26 NYCC 2 7/10
COS, mg/km	27.	2.9	26.	20.	17.	3.5	118.	75.
$(CH_3)_2S$, mg/km	5.0	4.1	3.4	5.9	2.8	2.0	15.	14.
$(C_2H_5)_2S$, mg/km	0	0	0	0	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	0	0	0

TABLE K-9. ORGANIC SULFIDE RESULTS FOR TURBOCHARGED FIAT DIESEL WITH UNDERFLOOR CATALYTIC TRAP, EM-329-F FUEL

Test Code No.	3B1F01	3B1F05	3B1F01	3B1F05	3B1H02	3B1H06	3B1N03	3B1N07
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC
Run No.	1	2	1	2	1	2	1	2
Date (1981)	9/17	9/18	9/17	9/18	9/17	9/18	9/17	9/18
COS, mg/km	20.	8.3	--[a]	21.	13.	9.6	113.	94.
$(CH_3)_2S$, mg/km	0.51	2.2	--	2.1	3.0	1.1	26.	26.
$(C_2H_5)_2S$, mg/km	0	0	--	0	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	--	0	0	0	0	0

[a] Sample lost during analysis

TABLE K-10. ORGANIC SULFIDE RESULTS FOR TURBOCHARGED FIAT DIESEL WITH UNDERFLOOR CATALYTIC TRAP, EM-469-F FUEL

Test Code No.	3B2F35	3B2F39	3B2F35	3B2F39	3B2H36	3B2H40	3B2N37	3B2N41
Test Type	C-FTP	C-FTP	H-FTP	H-FTP	HFET	HFET	NYCC	NYCC
Run No.	1	2	1	2	1	2	1	2
Date (1981)	9/23	9/24	9/23	9/24	9/23	9/24	9/23	9/24
COS, mg/km	34.	35.	24.	19.	18.	15.	164.	137.
$(CH_3)_2S$, mg/km	0.15	8.3	0.23	3.1	1.0	2.6	12.	43.
$(C_2H_5)_2S$, mg/km	0	0	0	0	0	0	0	0
$(CH_3)_2S_2$, mg/km	0	0	0	0	0	0	0	0

APPENDIX L

FORMAL REPORTS
FOR
ANALYSIS OF N-NITROSAMINES
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

Thermo Electron
CORPORATION

Analytical Services Laboratory

101 First Avenue
Waltham, Massachusetts 02154
(617) 890-8700

Telex: 92-3323
Cable: TEECORP

December 9, 1981

D. Montalvo
Southwest Research Institute
P.O. Box 28510
6220 Culebra Road
San Antonio, Texas 78284

Dear Mr. Montalvo:

In response to your recent inquiry regarding the analysis of Thermosorb Air Samplers by TEA Analyzer, I have outlined the conditions under which the analyses were performed. Should you desire further information, please do not hesitate to contact me.

Sincerely,

Wing C. Yu

Wing C. Yu
Manager, Analytical Services

WCY/sdg

Enclosure

SAMPLE PREPARATION:

Thermosorbs were eluted with a solution of 25% methanol in dichloromethane. 1.8ml of the eluant were collected and aliquots were analysed by GC-TEA or HPLC-TEA, whichever is applicable.

A. SAMPLE ANALYSIS

Chromatograph:	Hewlett Packard 5710A Gas Chromatograph and 7671A Automatic Sampler
Column:	1/4" x 6' Glass 10% Carbowax + 0.5% KOH on Chromosorb WHP 800/100 mesh
Column Temperature:	130°C - 170°C at 4°C/min., 2 minute hold at 170°C
Carrier:	He @ 20 cc/min.
Detector:	TEA™ Model 543 Analyzer (Thermo Electron Corporation, Analytical Instruments, Waltham, MA 02254)
Attenuation:	x 1
Integrator:	Spectra Physics SP 4000
Amount Injected:	4.5 µl

B. SAMPLE ANALYSIS

Chromatographs:	High Performance Liquid Chromatograph
Column:	10 µm 4.6 x 250 mm Lichrosorb Si60
Solvent:	7% acetone, 93% isooctane
Flow Rate:	2.0 ml/min.
Chart Speed:	0.2 inch/min.
Detector:	TEA™ Model 502 Analyzer (Analytical Instruments, Thermo Electron Corporation, Waltham, MA 02254)
Attenuation:	x 8
Amount Injected:	20 µl

Thermo Electron
CORPORATION

Analytical Services Laboratory

125 Second Avenue
Waltham, Massachusetts 02154
(617) 890-8700

Telex: 92-3473
Cable: TEECORP

FORMAL REPORT OF ANALYSIS
FOR
N-NITROSO COMPOUNDS

Prepared for:

Southwest Research Institute
P.O. Box 28510
6220 Culebra Road
San Antonio, TX 78284

Attn: Karl Springer

Date: May 18, 1981

Report No.: 5510-2700

Notebook Page: A-1020-57

Approved by: ______________________________
Laboratory Supervisor

SUMMARY OF RESULTS Thermosorbs

Customer Sample Number	NDMA[1] ng	NDEA[1] ng	NDPA[1] ng	NDBA[1] ng	NPIP[1] ng	NPYR[1] ng	NMOR[1] ng
17692	-[2]	-	-	-	-	-	-
17700	-	-	-	-	-	-	-
17701	-	-	-	-	-	-	-
17703	-	-	-	-	-	-	-

1. N-nitroso compounds in nanograms per thermosorb cartridge.
2. N.D.: none detected.

Lower limit of detection: LLD 10 ng per cartridge for NDMA
10 ng per cartridge for NDEA, NDPA, NPIP, NPYR, NMOR
10 ng per cartridge for NDBA

3. Trace: less than 3 x LLD

Date of Analysis: 4/29/81, 5/12/81

Method of Analysis: HPLC-TEA

Analyst: Pat Stebbins

ABBREVIATIONS:

NDMA - N-nitrosodimethylamine
NDEA - N-nitrosodiethylamine
NDPA - N-nitrosodipropylamine
NDBA - N-nitrosodibutylamine
NPIP - N-nitrosopiperidine
NPYR - N-nitrosopyrrolidine
NMOR - N-nitrosomorpholine
NDElA - N-nitrosodiethanolamine
NDPlA - N-nitrosodipropanolamine
NDiPlA- N-nitrosodiisopropanolamine
NNN - N-nitrosonornicotine
NDCHA - N-nitrosodicyclohexylamine
NMA - N-nitroso-N-methylaniline
NDPhA - N-nitrosodiphenylamine
NPhBA - N-nitrosophenylbenzylamine
NMBA - N-nitrosomethylbenzylamine
NMDoA - N-nitrosomethyldodecylamine
NMAA - N-nitrosomethylalkylamine
NDAA - N-nitrosodiamylamine

ppt - parts-per-thousand (mg/g or mg/ml)
ppm - parts-per-million (ug/g or ug/ml)
ppb - parts-per-billion (ng/g or ng/ml)
N.D. - None Detected

Thermo Electron
CORPORATION

Analytical Services Laboratory

125 Second Avenue
Waltham, Massachusetts 02154
(617) 890-8700

Telex: 92-3473
Cable: TEECORP

FORMAL REPORT OF ANALYSIS
FOR
N-NITROSO COMPOUNDS

Prepared for: Southwest Research Institute
P.O. Box 28510
6220 Culebra Road
San Antonia, Texas 78284
Attn: Karl Springer

Date: July 13, 1981

Report No.: 5510-2849

Notebook Page: A1020-94

Approved by: Wing C. Yu

SUMMARY OF RESULTS Thermosorbs

Customer Sample Number	NDMA[1] ng	NDEA[1] ng	NDPA[1] ng	NDBA[1] ng	NPIP[1] ng	NPYR[1] ng	NMOR[1] ng
17693	-[2]	-	-	-	-	-	-
17694	-	-	-	-	-	-	-

1. N-nitroso compunds in nanograms per thermosorb cartridge.
2. N.D.: none detected.

Lower limit of detection: LLD

10 ng per cartridge for NDMA
10 ng per cartridge for NDEA, NDPA, NPIP, NPYR, NMOR
10 ng per cartridge for NDBA

3. Trace: less than 3 x LLD

Date of Analysis: 7/10/81

Method of Analysis: HPLC - TEA

Analysits: Linda Cantor

Thermo
Electron
CORPORATION

Analytical Services Laboratory

125 Second Avenue
Waltham, Massachusetts 02154
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Telex: 92-3473
Cable: TEECORP

FORMAL REPORT OF ANALYSIS
FOR
N-NITROSO COMPOUNDS

Prepared for: South Research Institute
8500 Culebra
San Antonio, TX 78284

Date: September 10, 1981

Report No.: 5510-3029

Notebook Page: A-1040-26

Approved by: Ulku Goff

SUMMARY OF RESULTS Thermosorbs

Customer Sample Number	NDMA[1] ng	NDEA[1] ng	NDPA[1] ng	NDBA[1] ng	NPIP[1] ng	NPYR[1] ng	NMOR[1] ng
17695	-(2)	-	-	-	-	-	-
17696	-	-	-	-	-	-	-

1. N-nitroso compounds in nanograms per thermosorb cartridge.
2. N.D.: none detected.

Lower limit of detection: LLD 5 ng per cartridge for NDMA
8 ng per cartridge for NDEA, NDPA, NPIP, NPYR, NMOR
10 ng per cartridge for NDBA

3. Trace: less than 3 x LLD

Date of Analysis: 9/1/81

Method of Analysis: GC-TEA

Analysts: Patricia Stebbins

ABBREVIATIONS:

NDMA - N-nitrosodimethylamine
NDEA - N-nitrosodiethylamine
NDPA - N-nitrosodipropylamine
NDBA - N-nitrosodibutylamine
NPIP - N-nitrosopiperidine
NPYR - N-nitrosopyrrolidine
NMOR - N-nitrosomorpholine
NDElA - N-nitrosodiethanolamine
NDPlA - N-nitrosodipropanolamine
NDiPlA- N-nitrosodiisopropanolamine
NNN - N-nitrosonornicotine
NDCHA - N-nitrosodicyclohexylamine
NMA - N-nitroso-N-methylaniline
NDPhA - N-nitrosodiphenylamine
NPhBA - N-nitrosophenylbenzylamine
NMBA - N-nitrosomethylbenzylamine
NMDoA - N-nitrosomethyldodecylamine
NMAA - N-nitrosomethylalkylamine
NDAA - N-nitrosodiamylamine

ppt - parts-per-thousand (mg/g or mg/ml)
ppm - parts-per-million (ug/g or ug/ml)
ppb - parts-per-billion (ng/g or ng/ml)
N.D. - None Detected

Thermo
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CORPORATION

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FORMAL REPORT OF ANALYSIS
FOR
N-NITROSO COMPOUNDS

Prepared for: Southwest Research Institute
8500 Culebra
San Antonio, Texas 78284

Attn: D. Montalvo

Date: November 11, 1981

Report No.: 5510-3191

Notebook Page: A1040-53

Approved by: ______________________________

L-12

SUMMARY OF RESULTS: Thermosorbs

Customer Sample Number	NDMA[1] ng	NDEA[1] ng	NDPA[1] ng	NDBA[1] ng	NPIP[1] ng	NPYR[1] ng	NMOR[1] ng
17698	-[2]	-	-	-	-	-	-
11824	-	-	-	-	-	-	-

1. N-nitroso compounds in nanograms per thermosorb cartridge.
2. N.D.: None Detected
   Lower Limit of Detection: LLD 40 ng per cartridge for NDMA
   50 ng per cartridge for NDEA, NDPA NPIP, NPYR, NMOR
   80 ng per cartridge for NDBA

Date of Analysis: 11/9/91

Method of Analysis: HPLC-TEA

Analyst: Linda Cantor

ABBREVIATIONS:

NDMA - N-nitrosodimethylamine
NDEA - N-nitrosodiethylamine
NDPA - N-nitrosodipropylamine
NDBA - N-nitrosodibutylamine
NPIP - N-nitrosopiperidine
NPYR - N-nitrosopyrrolidine
NMOR - N-nitrosomorpholine
NDElA - N-nitrosodiethanolamine
NDPlA - N-nitrosodipropanolamine
NDiPlA- N-nitrosodiisopropanolamine
NNN - N-nitrosonornicotine
NDCHA - N-nitrosodicyclohexylamine
NMA - N-nitroso-N-methylaniline
NDPhA - N-nitrosodiphenylamine
NPhBA - N-nitrosophenylbenzylamine
NMBA - N-nitrosomethylbenzylamine
NMDoA - N-nitrosomethyldodecylamine
NMAA - N-nitrosomethylalkylamine
NDAA - N-nitrosodiamylamine

ppt - parts-per-thousand (mg/g or mg/ml)
ppm - parts-per-million (ug/g or ug/ml)
ppb - parts-per-billion (ng/g or ng/ml)
N.D. - None Detected

APPENDIX M

VISIBLE SMOKE DATA
OF
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

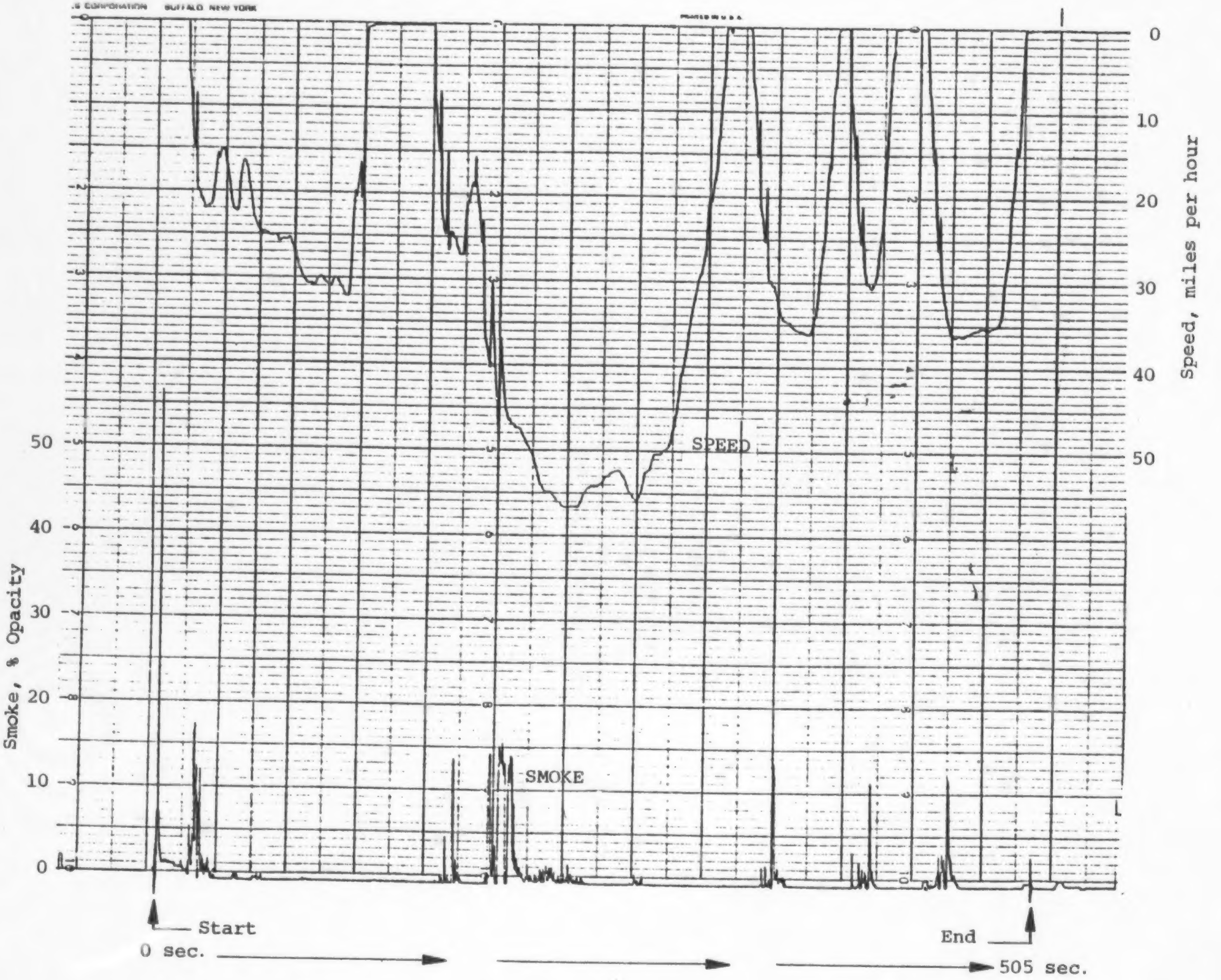

Figure M-1. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat, N.A. diesel, no aftertreatment, EM-329-F fuel, 2/5/81

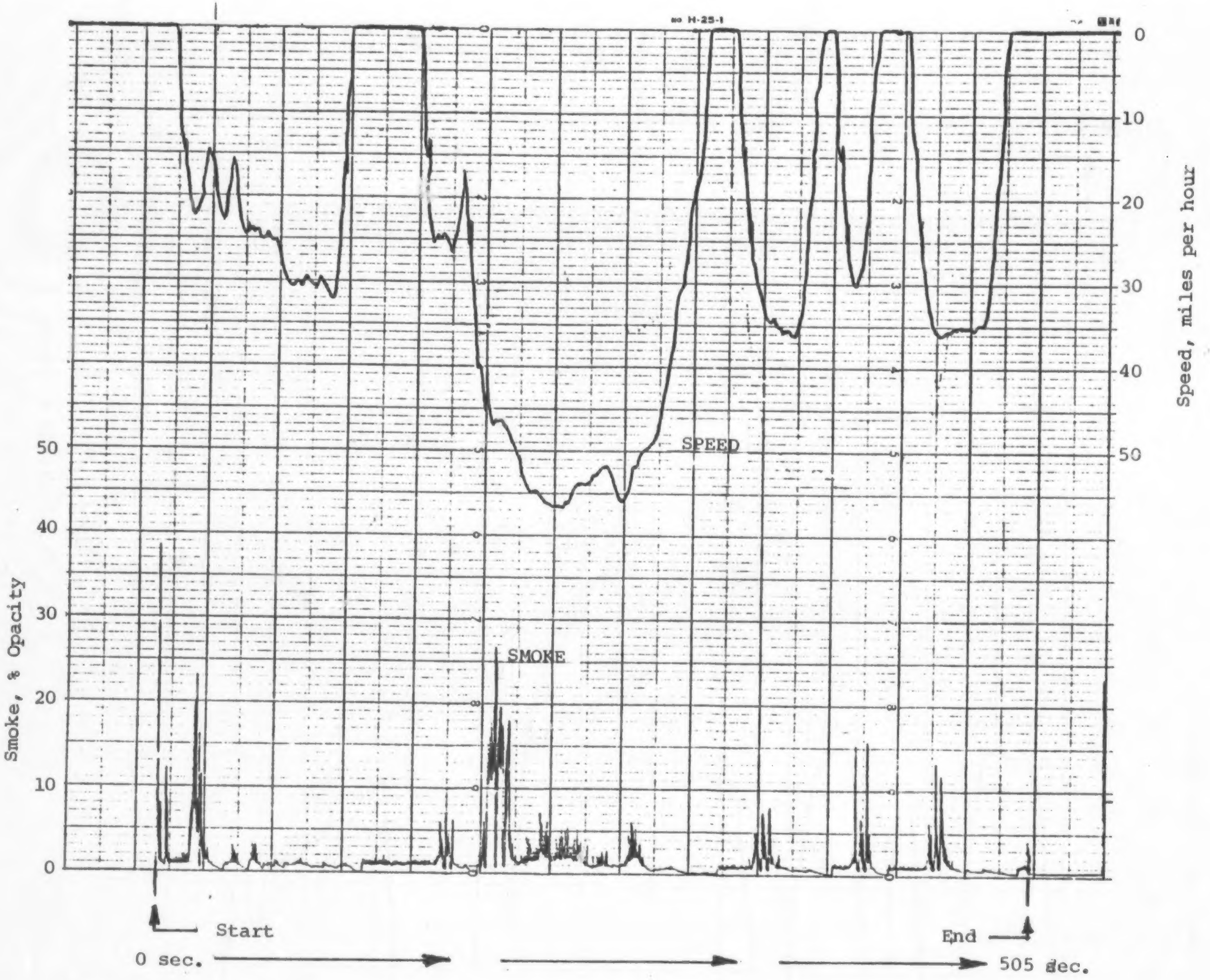

Figure M-2. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat, N.A. diesel, no aftertreatment, EM-469-F fuel, 3-23-81

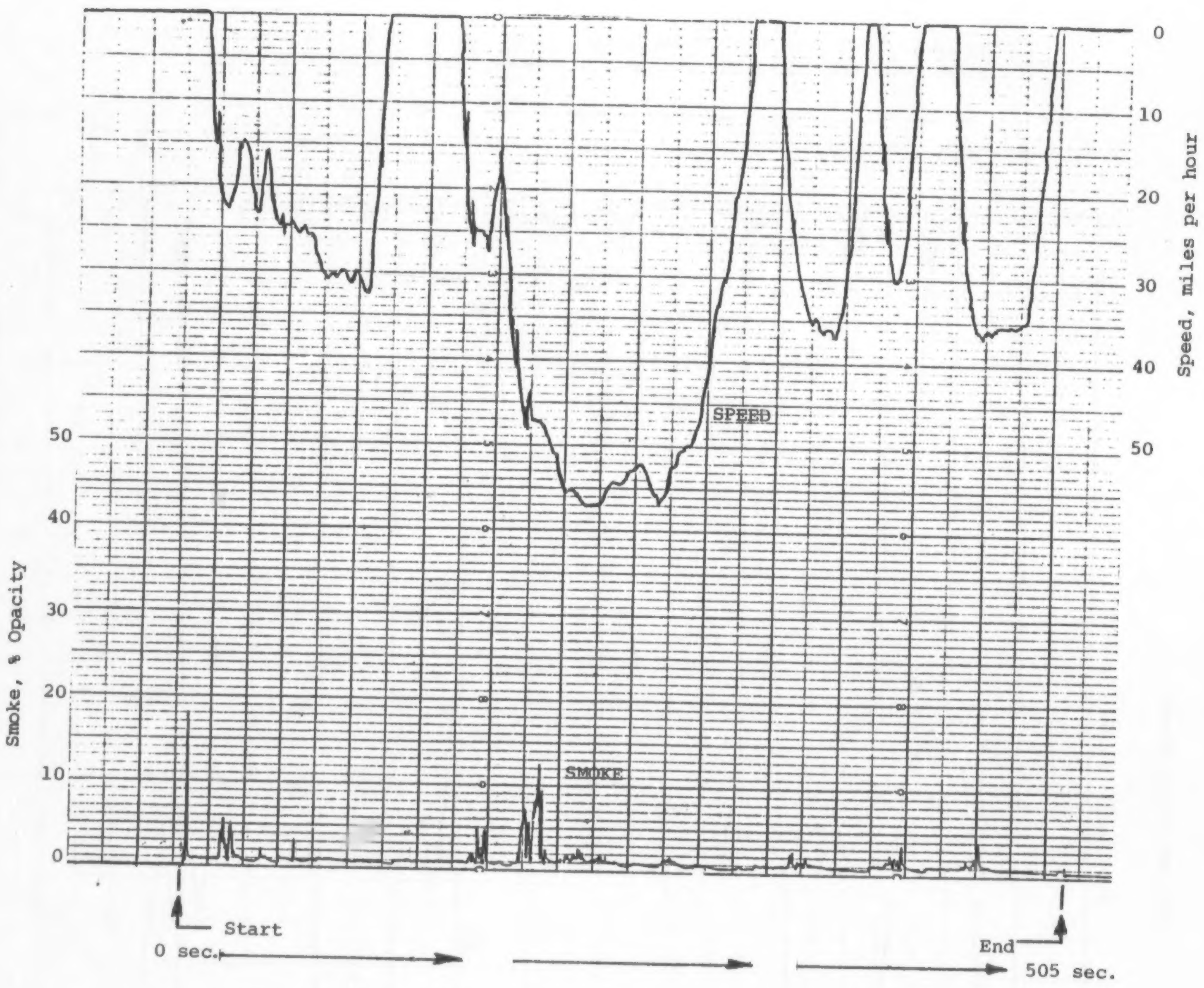

Figure M-3. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat, N.A. diesel with catalytic trap, EM-329-F fuel, 4/14/81

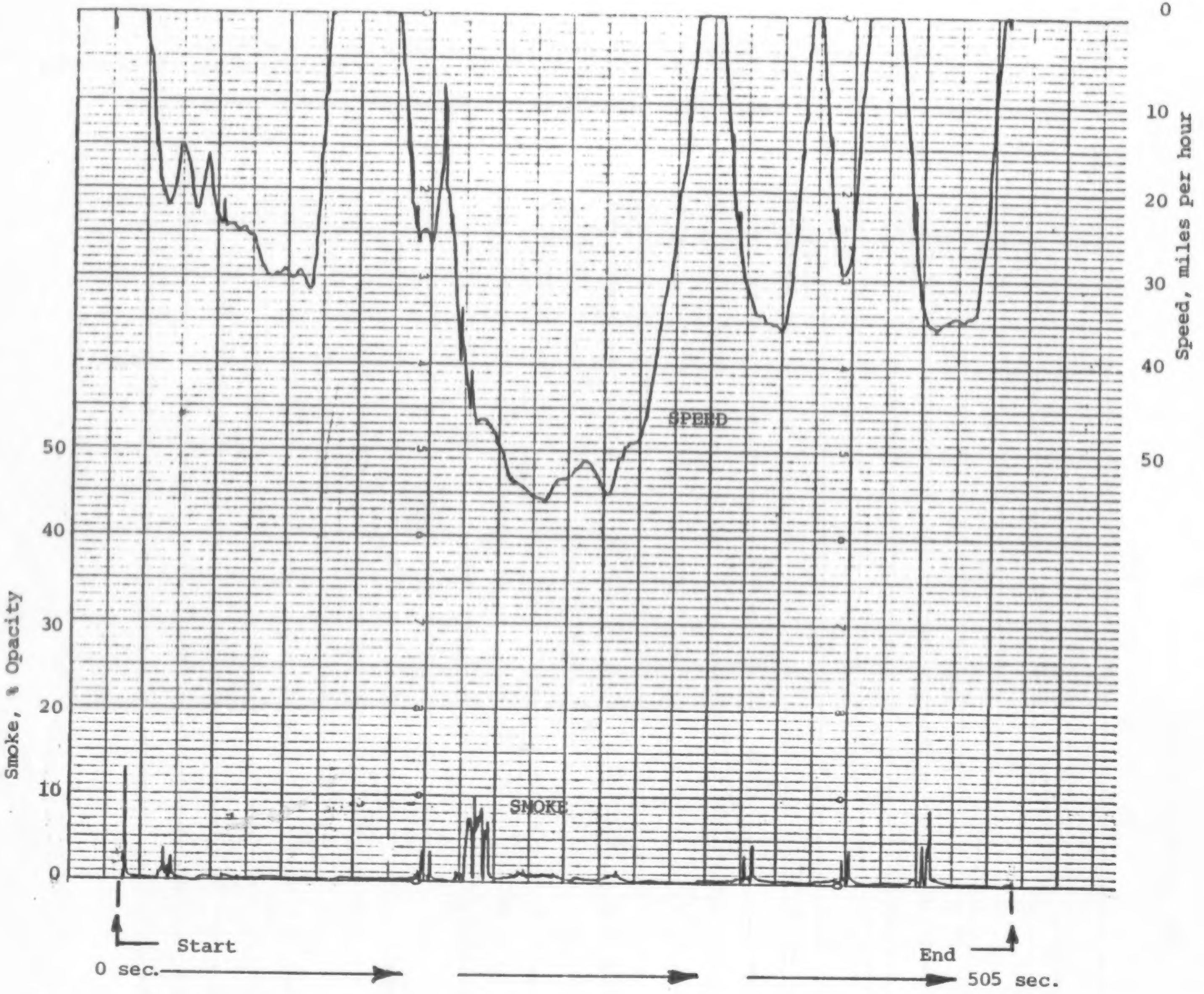

Figure M-4. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat, N.A. diesel with catalytic trap, EM-469-F fuel, 4/22/81

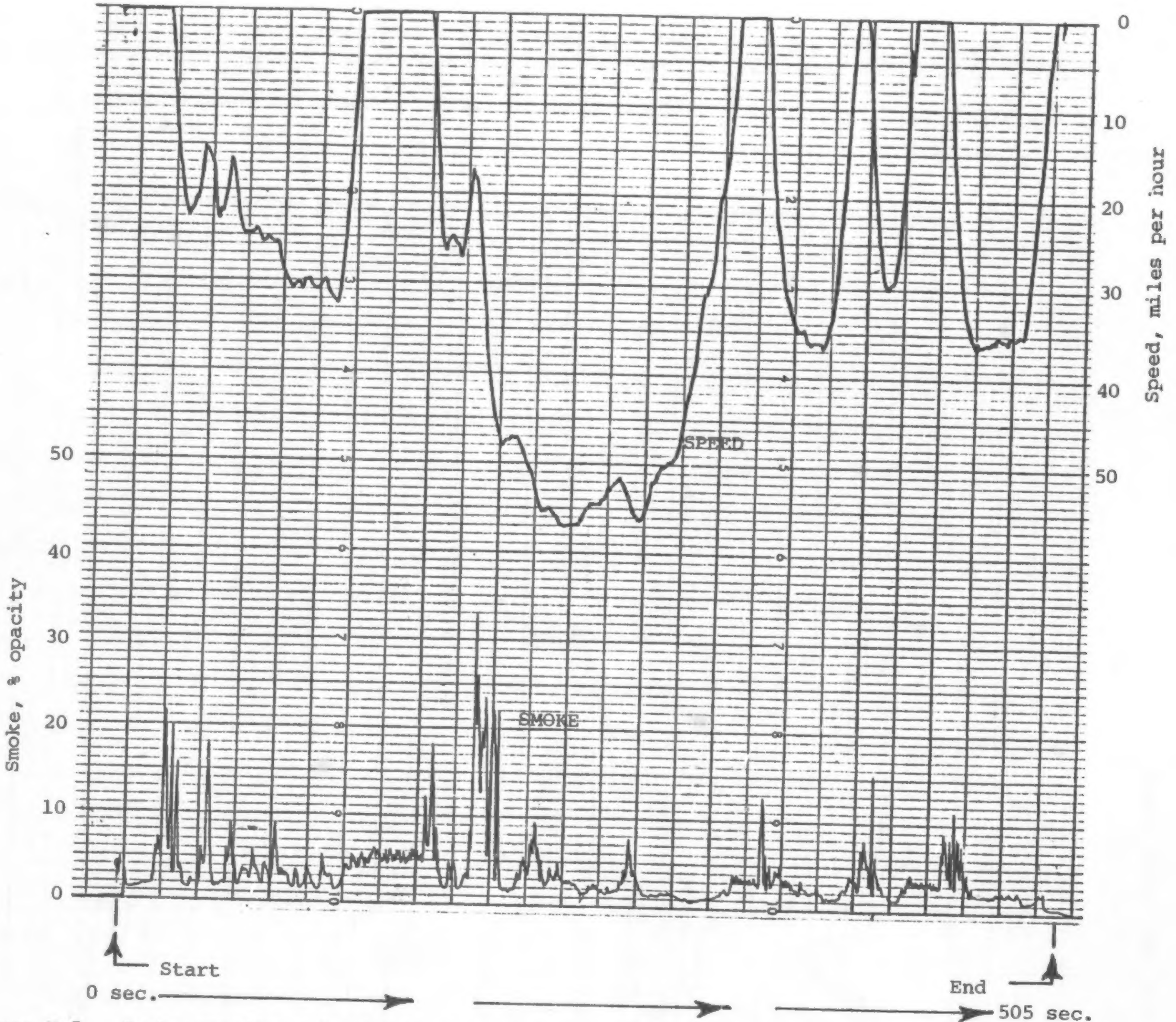

Figure M-5. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, 1981 Oldsmobile Cutlass Diesel, EM-329-F fuel, 5/28/81

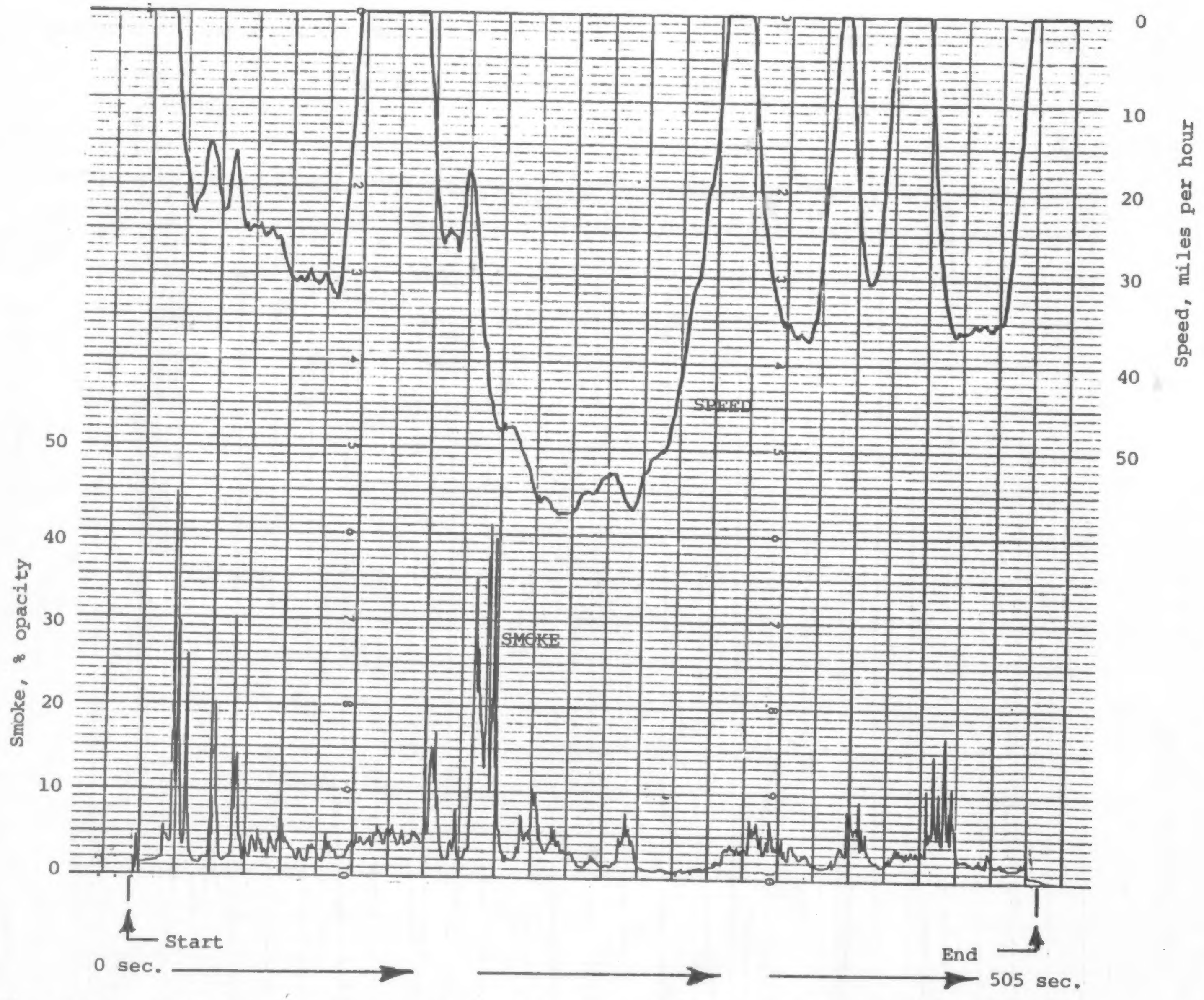

Figure M-6. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, 1981 Oldsmobile Cutlass Diesel, EM-469-F fuel, 6/24/81

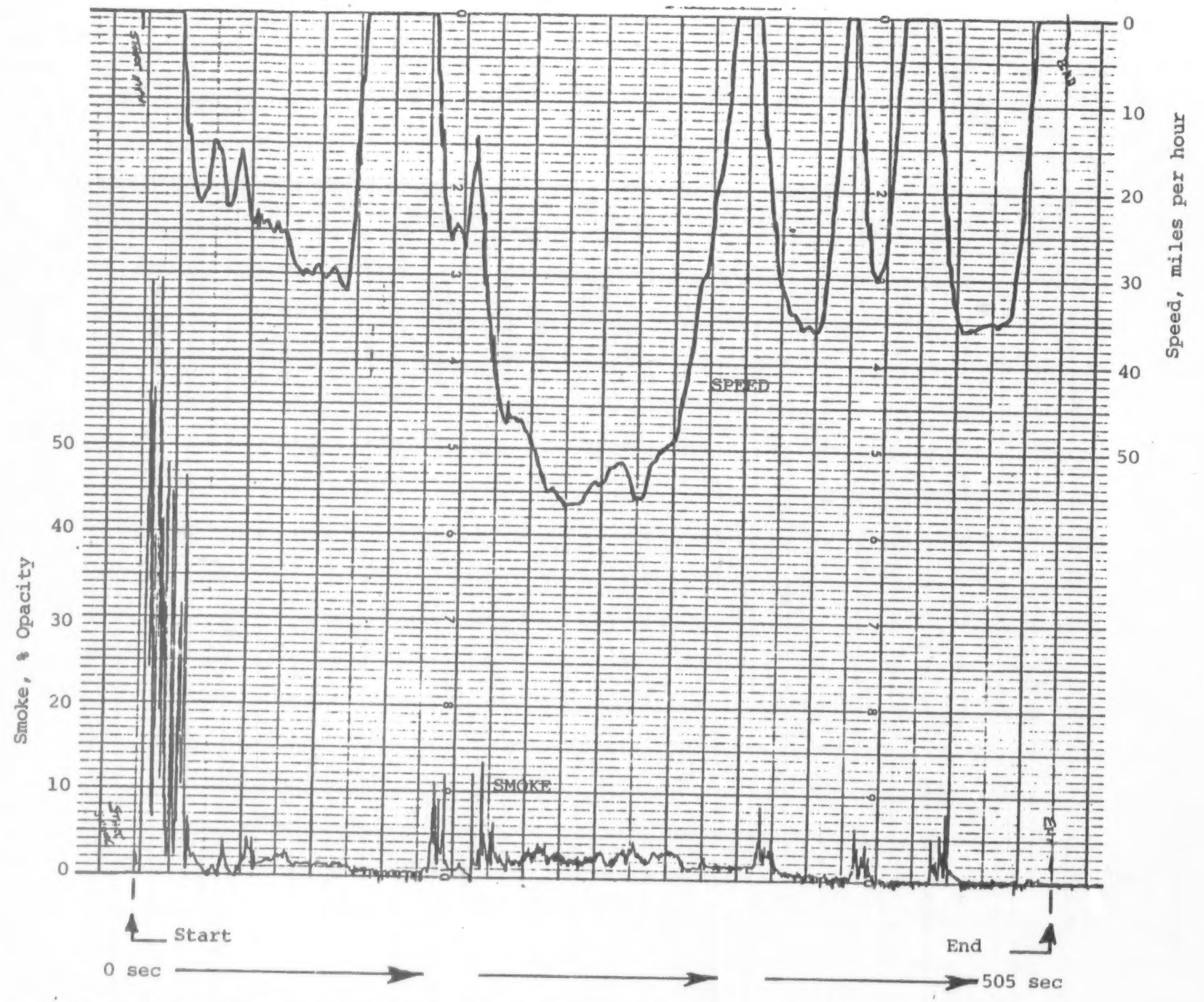

Figure M-7. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat T.C. diesel, no aftertreatment, EM-329-F fuel, 7-7-81

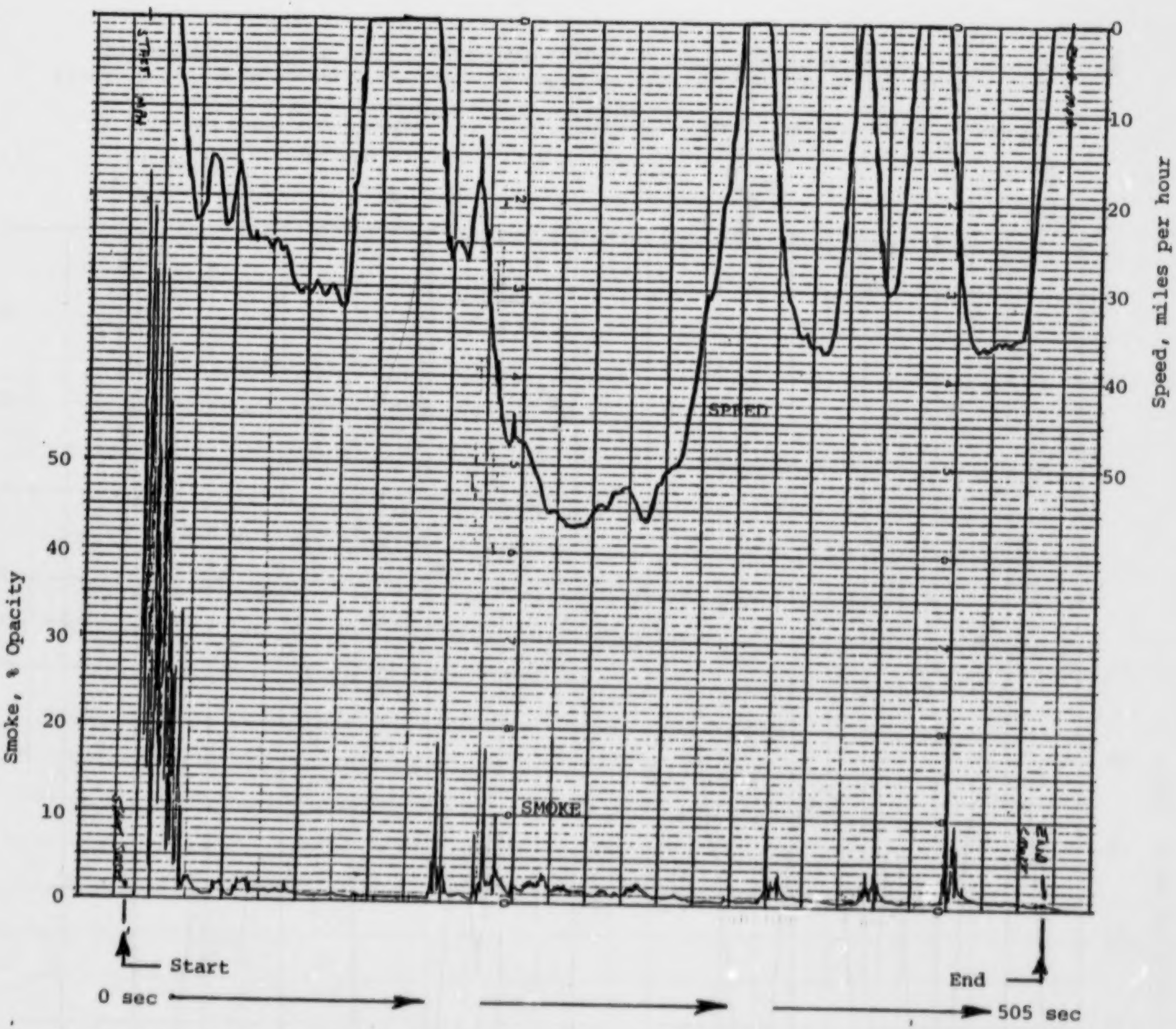

Figure M-8. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat T.C. diesel, no aftertreatment, EM-469-F fuel, 7-16-81

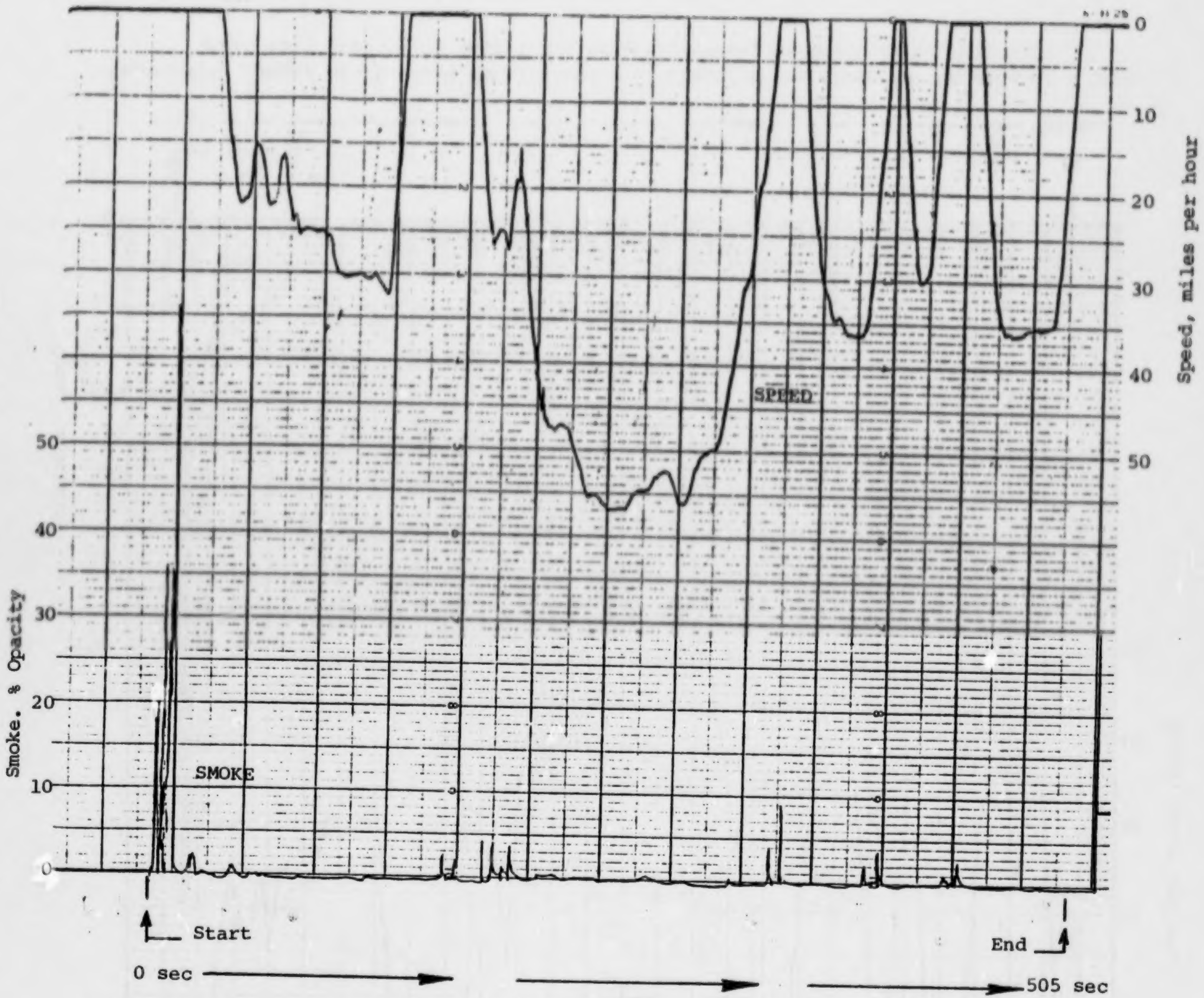

Figure M-9. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat T.C. diesel with catalytic trap, EM-329-F fuel, 9-22-81

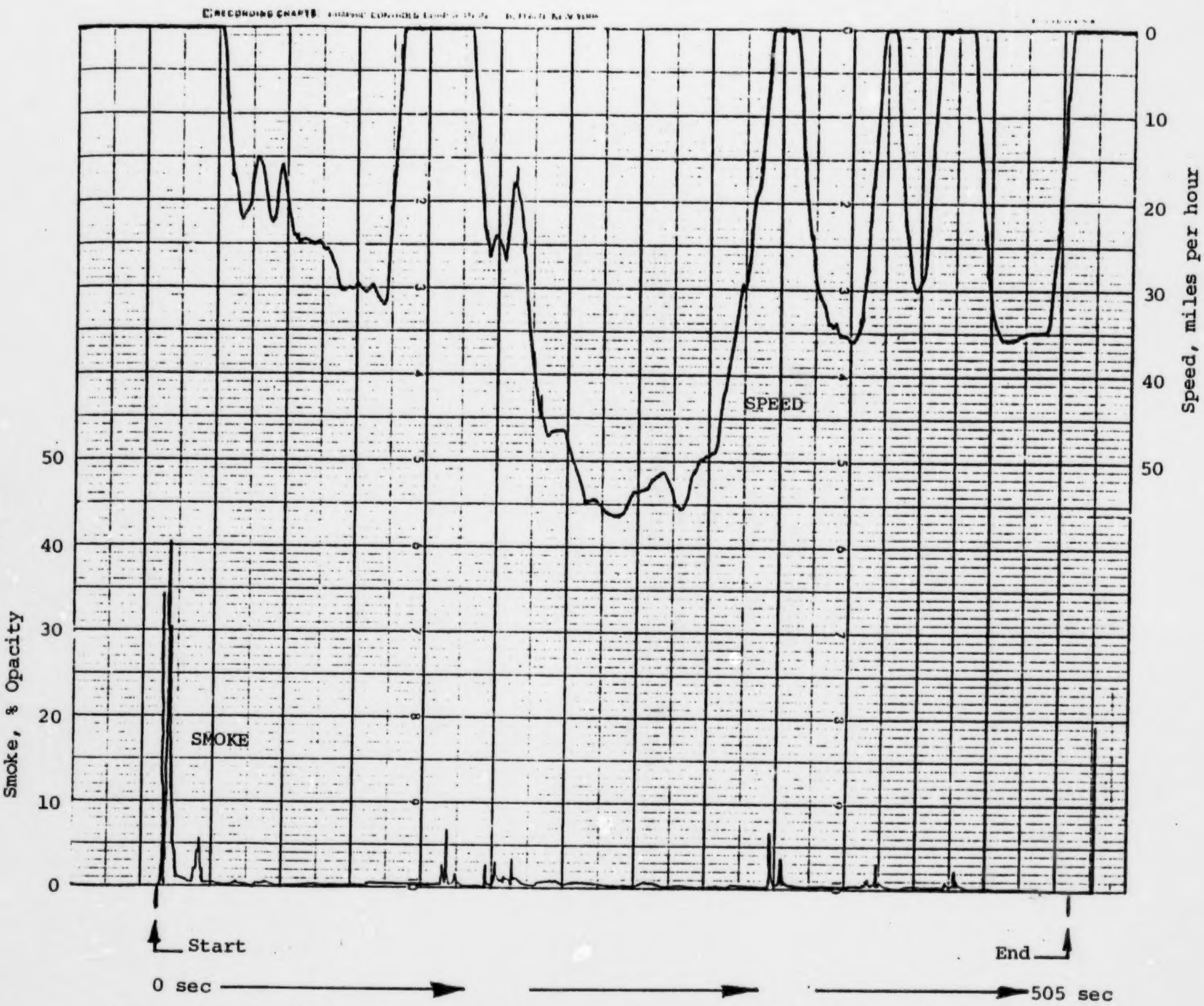

Figure M-10. Smoke opacity and vehicle speed vs time for the first 505 seconds of a cold-start FTP, Fiat T.C. diesel with catalytic trap, EM-469-F fuel, 10-2-81

APPENDIX N

ELEMENTAL ANALYSES
OF
PARTICULATE MATTER
OBTAINED ON
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

TABLE N-1. ELEMENTAL ANALYSES OF PARTICULATE MATTER FROM NATURALLY-ASPIRATED FIAT DIESEL, NO AFTERTREATMENT, FUELS EM-329-F AND EM-469-F

Test Type	4-bag FTP		HFET		NYCC		85 kph	
Test Code	1A329F	1A2F29	1A329H	1A2H30	1A329N	1A2N31	1A329S	1A2S32
Fuel Code	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Run No.	5	2	5	2	5	2	5	2
Date (1981)	1/30	2/18	1/30	2/18	1/30	2/18	1/30	2/18
Elements, mg/km								
Sodium	-[b]	0.02	-	0.02	0.21	-	-	0.01
Sulfur	1.05	0.81	0.31	0.48	1.87	1.47	0.21	0.11
Vanadium	-	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-
Magnesium	0.04	0.04	0.01	0.01	0.09	0.09	0.01	0.01
Chlorine	0.01	0.01	0.01	0.01	-	-	-	-
Chromium	-	0.04	0.08	-	0.41	0.18	0.06	0.04
Copper	-	-	-	-	-	-	0.01	0.01
Tin	-	0.01	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-
Aluminum	0.03	0.01	0.01	-	0.05	-	-	-
Potassium	0.01	0.01	-	0.01	-	-	0.01	0.01
Manganese	-	0.02	0.04	-	0.22	-	-	0.02
Zinc	0.16	0.17	-	0.07	0.33	0.29	0.03	0.02
Antimony	-	0.01	0.01	-	0.04	-	0.01	-
Silicon	0.09	0.06	0.02	0.02	0.21	0.16	0.01	0.01
Calcium	0.17	0.13	0.04	0.03	0.35	0.17	0.01	0.01
Iron	0.34	0.22	0.04	0.08	0.57	0.36	0.03	0.02
Selenium	-	-	-	-	-	-	-	-
Barium	0.02	0.01	0.01	0.01	0.09	0.03	-	-
Phosphorus	0.10	0.09	0.02	0.05	0.25	0.22	0.02	0.01
Titanium	0.01	0.01	-	-	-	-	-	-
Bromine	-	0.03	0.00	0.08	-	0.36	0.09	0.08
Platinum	-	-	0.00	-	-	-	-	-
Strontium[c]	-	-	-	-	-	-	-	-
Molybdenum[c]	-	-	-	-	-	-	-	-
Tungsten[c]	-	-	-	-	-	-	-	-
Arsenic[c]	-	-	-	-	-	-	-	-
Total Percent of Particulate Rate	1.7	1.5	1.5	1.3	2.1	1.6	1.7	1.7
Vehicle Particulate Rate, mg/km[a]	120.	116.	40.	67.	228.	207.	30.	21.

[a] based on data from 47mm Fluoropore filter data

[b] 0.00 mg/km

[c] elements studied, but not sought in this particular analysis

Note: Cobalt analyzed for, but not found.

TABLE N-2. ELEMENTAL ANALYSIS OF PARTICULATE MATTER FROM NATURALLY-ASPIRATED FIAT DIESEL WITH CATALYTIC TRAP, FUELS EM-329-F AND EM-469-F

Test Type	4-bag FTP		HFET		NYCC		85 kph	
Test Code	1B1F54	1B2F72	1B1H55	1B2H73	1B1N56	1B2N74	1B1S57	1B2S75
Fuel Code	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Run No.	3	3	3	3	3	3	3	3
Date (1981)	4/9	4/20	4/9	4/20	4/9	4/20	4/9	4/20
Elements, mg/km								
Sodium	-[b]	-	-	-	-	-	-	-
Sulfur	0.25	0.23	1.72	1.32	0.70	0.70	3.62	2.64
Vanadium	-	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	0.02	-	-
Mercury	-	-	-	-	-	-	-	-
Magnesium	0.03	0.03	0.01	0.01	0.08	0.08	-	-
Chlorine	-	0.01	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-	-
Tin	0.01	-	-	-	-	-	0.01	-
Lead	-	-	-	-	-	-	-	-
Aluminum	0.05	0.04	0.01	0.01	0.15	0.12	-	-
Potassium	0.01	0.01	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-
Zinc	0.04	0.05	0.03	0.04	0.10	0.11	0.04	0.03
Antimony	-	-	-	-	-	-	-	-
Silicon	0.11	0.11	0.02	0.02	0.35	0.31	0.01	0.01
Calcium	0.07	0.11	0.03	0.04	0.27	0.39	0.01	0.01
Iron	0.26	0.26	0.08	0.04	0.89	1.07	0.01	0.01
Selenium	-	-	-	-	-	-	-	-
Barium	0.01	0.01	0.01	-	0.06	0.06	0.01	0.01
Phosphorus	0.06	0.01	-	0.01	-	-	0.01	-
Titanium	0.01	0.01	0.01	-	0.04	0.04	-	-
Bromine	-	-	-	-	-	-	-	-
Platinum	-	-	-	-	-	-	-	-
Strontium	-	-	0.01	-	-	-	-	-
Molybdenum	-	-	-	-	-	-	-	-
Tungsten	-	-	0.06	-	-	-	0.03	-
Arsenic	-	-	-	-	-	-	-	-
Total Percent of Particulate Rate	3.4	3.1	6.6	6.5	4.1	5.5	6.6	11.8
Vehicle Particulate Rate, mg/km[a]	27.	28.	30.	23.	64.	53.	57.	23.

[a] based on data from 47mm Fluoropore filter data

[b] 0.00 mg/km

Note: Cobalt analyzed for, but not found.

TABLE N-3. ELEMENTAL ANALYSES OF PARTICULATE MATTER FROM 1981 OLDSMOBILE CUTLASS DIESEL, FUEL EM-329-F AND EM-469-F

Test Type	4-bag FTP		HFET		NYCC		85 kph	
Test Code	2A1F01	2A2F26	2A1H02	2A2H27	2A1N03	2A2N28	2A1S04	2A2S29
Fuel Code	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Run No.	1	3	1	3	1	3	1	3
Date (1981)	5/21	6/19	5/21	6/19	5/21	6/19	5/21	6/19
Elements, mg/km								
Sodium	-[b]	-	-	-	-	-	-	-
Sulfur	0.78	0.92	1.09	0.98	1.79	2.29	0.79	0.79
Vanadium	0.01	0.01	-	-	0.09	-	-	-
Nickel	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-
Magnesium	0.01	0.01	0.01	-	0.04	0.08	-	0.01
Chlorine	0.01	0.02	0.02	0.01	0.03	0.04	0.02	-
Chromium	0.01	-	0.09	0.06	0.39	0.53	-	-
Copper	-	0.01	-	0.01	-	-	0.01	0.01
Tin	-	-	0.01	-	-	-	-	-
Lead	-	-	-	0.10	-	0.98	-	-
Aluminum	0.01	0.01	-	0.01	-	-	-	-
Potassium	-	0.01	-	-	-	-	-	-
Manganese	0.01	-	0.06	0.05	0.22	0.32	-	0.01
Zinc	0.03	0.06	0.01	0.03	-	0.07	0.01	0.03
Antimony	-	-	0.01	0.01	-	-	-	-
Silicon	0.01	0.05	0.01	0.02	0.05	0.09	-	0.01
Calcium	0.04	0.14	0.04	0.04	0.15	0.18	0.01	0.01
Iron	0.16	0.49	0.09	0.18	0.22	0.29	0.01	0.03
Selenium	-	-	-	-	0.35	-	-	-
Barium	-	0.01	0.01	0.01	0.07	-	-	-
Phosphorus	0.05	0.05	0.04	0.03	0.16	0.21	0.01	0.02
Titanium	-	0.01	0.01	0.01	0.03	-	0.04	-
Bromine	-	-	-	-	-	0.51	-	-
Platinum	-	-	-	-	-	-	-	-
Strontium	-	-	-	-	-	-	-	-
Molybdenum	-	-	-	-	-	-	-	-
Tungsten	-	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-	-
Total Percent of Particulate Rate	1.2	1.3	1.5	1.4	1.7	1.7	1.4	1.3
Vehicle Particulate Rate, mg/km[a]	97.	136.	100.	110.	217.	322.	66.	72.

[a] based on data from 47mm Fluoropore filter data

[b] 0.00 mg/km

Note: Cobalt analyzed for, but not found.

TABLE N-4. ELEMENTAL ANALYSES OF PARTICULATE MATTER FROM TURBOCHARGED FIAT DIESEL WITHOUT AFTERTREATMENT, EM-329-F AND EM-469-F

Test Type	4-bag FTP		HFET		NYCC		85 kph	
Test Code	3A1F01	3A2F20	3A1H02	3A2H21	3A1N03	3A1N22	3A1S04	3A1S23
Fuel Code	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Run No.	1	1	1	1	1	1	1	1
Date (1981)	6/26	7/9	6/26	7/9	6/26	7/9	6/26	7/9
Elements, mg/km								
Sodium	-[b]	-	-	-	-	-	-	-
Sulfur	1.21	0.79	0.83	0.59	1.44	0.94	0.77	0.56
Vanadium	0.01	-	-	-	-	-	0.01	-
Nickel	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-
Magnesium	0.02	0.02	-	0.01	0.07	0.06	-	-
Chlorine	-	-	0.01	-	-	-	-	-
Chromium	0.01	-	-	-	-	-	-	-
Copper	-	0.01	-	-	-	-	-	-
Tin	0.01	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-
Aluminum	0.03	0.01	0.01	-	0.04	0.01	-	-
Potassium	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-
Zinc	0.08	0.09	0.01	0.04	0.02	0.16	0.01	0.02
Antimony	-	-	-	-	-	-	-	-
Silicon	0.04	0.01	0.01	-	0.09	-	-	-
Calcium	0.11	0.09	0.02	0.01	0.28	0.19	0.01	0.01
Iron	0.50	0.19	-	-	0.40	-	0.01	-
Selenium	-	-	-	-	-	-	-	-
Barium	0.01	-	-	-	-	-	-	-
Phosphorus	0.06	-	0.02	0.01	0.11	0.09	0.01	0.01
Titanium	0.01	-	-	-	0.01	-	-	-
Bromine	-	-	-	-	-	-	-	-
Platinum	-	-	-	-	-	-	-	-
Strontium	-	-	-	0.04	-	-	-	-
Molybdenum	0.01	-	-	0.04	0.30	-	-	-
Tungsten	-	-	-	-	0.04	-	-	-
Arsenic	-	-	-	-	-	-	-	-
Total Percent of Particulate Rate	3.0	2.1	2.2	2.5	2.4	1.3	2.6	2.0
Vehicle Particulate Rate, mg/km[a]	71.	58.	41.	30.	118.	114.	31.	30.

[a] based on data from 47mm Fluoropore filter data

[b] 0.00 mg/km

Note: Cobalt analyzed for, but not found.

TABLE N-5. ELEMENTAL ANALYSES OF PARTICULATE MATTER FROM TURBOCHARGED FIAT DIESEL WITH CATALYTIC TRAP, FUELS EM-329-F AND EM-469-F

Test Type	4-bag FTP		HFET		NYCC		85 kph	
Test Code	3B1F01	3B2F39	3B1H02	3B2H40	3B1N03	3B2N41	3B1S04	3B2S42
Fuel Code	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
Run No.	1	2	1	2	1	2	1	2
Date (1981)	9/17	9/24	9/17	9/24	9/17	9/24	9/17	9/24
Elements, mg/km								
Sodium	-[b]	-	-	-	-	-	-	-
Sulfur	0.44	0.51	0.37	1.77	0.59	0.74	1.01	2.26
Vanadium	-	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-
Magnesium	0.01	0.02	-	-	-	-	-	-
Chlorine	0.01	-	0.01	-	-	-	-	-
Chromium	0.01	-	0.03	-	0.10	0.37	-	-
Copper	-	-	-	-	-	-	-	-
Tin	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-
Aluminum	0.26	0.08	0.01	-	0.45	0.12	-	-
Potassium	-	-	-	-	-	-	-	-
Manganese	-	-	0.04	-	-	0.19	-	-
Zinc	0.09	0.11	0.03	0.04	0.30	0.14	0.05	0.02
Antimony	-	-	-	-	-	0.02	-	-
Silicon	-	-	-	-	-	-	-	-
Calcium	0.07	0.06	-	-	-	-	-	-
Iron	0.41	0.16	0.03	2.63	0.65	0.26	0.01	0.02
Selenium	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-
Phosphorus	0.04	0.03	0.01	0.01	0.08	-	0.01	-
Titanium	-	-	-	-	-	-	-	-
Bromine	-	-	-	-	-	-	-	-
Platinum	-	-	-	-	-	-	-	-
Strontium	-	-	-	-	-	-	0.05	-
Molybdenum	-	-	-	-	-	-	0.11	-
Tungsten	-	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-	-
Total Percent of Particulate Rate	2.6	2.0	1.8	9.5	2.9	2.4	3.9	7.0
Vehicle Particulate Rate, mg/km[a]	51	49	30	47	75	76	32	33

[a] based on data from 47mm Fluoropore filter data

[b] 0.00 mg/km

Note: Cobalt analyzed for, but not found.

APPENDIX O

ORGANIC SOLUBLES BOILING RANGE AND CHROMATOGRAMS

TABLE O-1. GAS CHROMATOGRAPH ANALYSIS[a] OF ORGANIC SOLUBLES IN PARTICULATE MATTER, FIAT N.A. DIESEL, NO AFTERTREATMENT, FUELS EM-329-F AND EM-469-F

Distillation Point	Temperature in C° by Cycle and Fuel							
	4-bag FTP		HFET		NYCC		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
IBP	301	322	338	306	372	301	316	324
10% point	--	440	423	401	400	372	411	378
20% point	--	--	489	445	420	388	464	396
30% point	--	--	640	492	442	401	--	413
40% point	--	--	--	--	464	413	--	430
50% point	--	--	--	--	496	425	--	449
60% point	--	--	--	--	--	437	--	468
70% point	--	--	--	--	--	449	--	493
80% point	--	--	--	--	--	463	--	525
90% point	--	--	--	--	--	477	--	621
EP	--	--	--	--	--	492	--	--
Recovery, %	4.2	17.5	29.9	36.3	56.4	120	29.0	90.6
@ Temperature, °C	640	531	640	531	530	493	530	640

[a] by modified ASTM D2887-73 simulated distillation

TABLE O-2. GAS CHROMATOGRAPH ANALYSIS[a] OF ORGANIC SOLUBLES IN PARTICULATE MATTER, FIAT N.A. DIESEL WITH CATALYTIC TRAP, FUELS EM-329-F AND EM-469-F

Distillation Point	Temperature in C° by Cycle and Fuel							
	4-bag FTP		HFET		NYCC[b]		85 kph	
	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F	EM-329-F	EM-469-F
IBP	340	319	361	378	--	--	350	400
10% point	389	380	426	423	--	--	425	476
20% point	412	402	470	466	--	--	471	597
30% point	435	424	530	566	--	--	525	--
40% point	464	451	582	615	--	--	582	--
50% point	508	492	--	--	--	--	--	--
60% point	557	557	--	--	--	--	--	--
70% point	589	615	--	--	--	--	--	--
80% point	--	--	--	--	--	--	--	--
90% point	--	--	--	--	--	--	--	--
EP	--	--	--	--	--	--	--	--
Recovery, %	75.6	72.0	47.0	41.6	--	--	45.0	26.2
@ Temperature, °C	603	640	603	639	--	--	603	638

[a] by modified ASTM D2887-73 simulated distillation

[b] insufficient sample for analysis

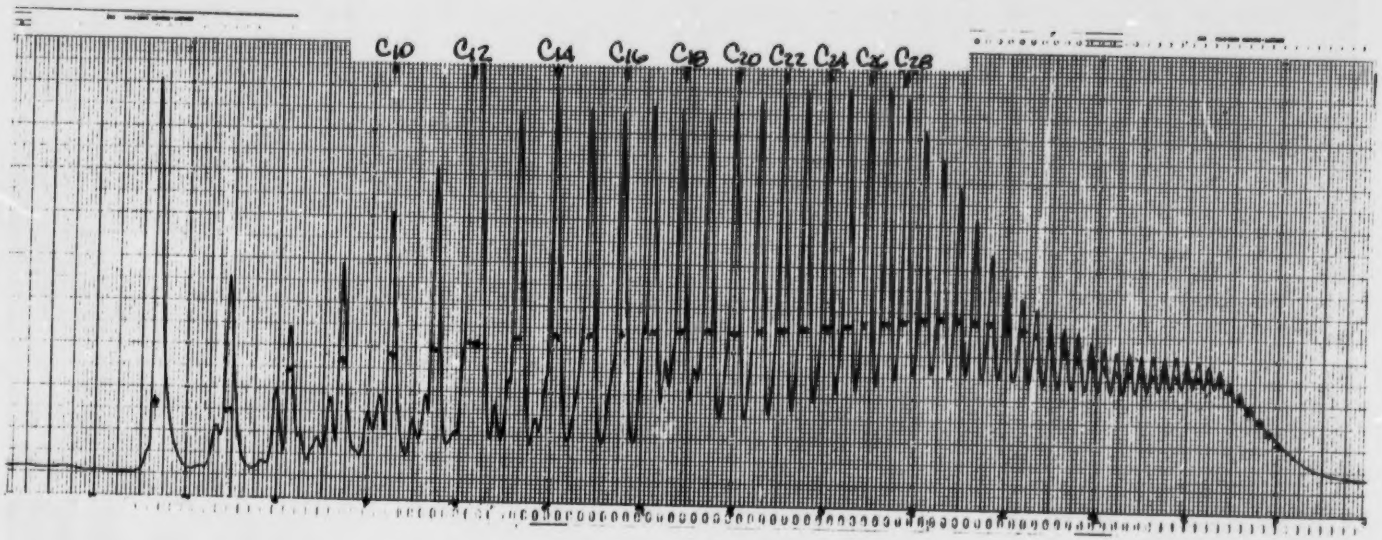

Figure O-1. "Altamont" crude oil chromatogram.

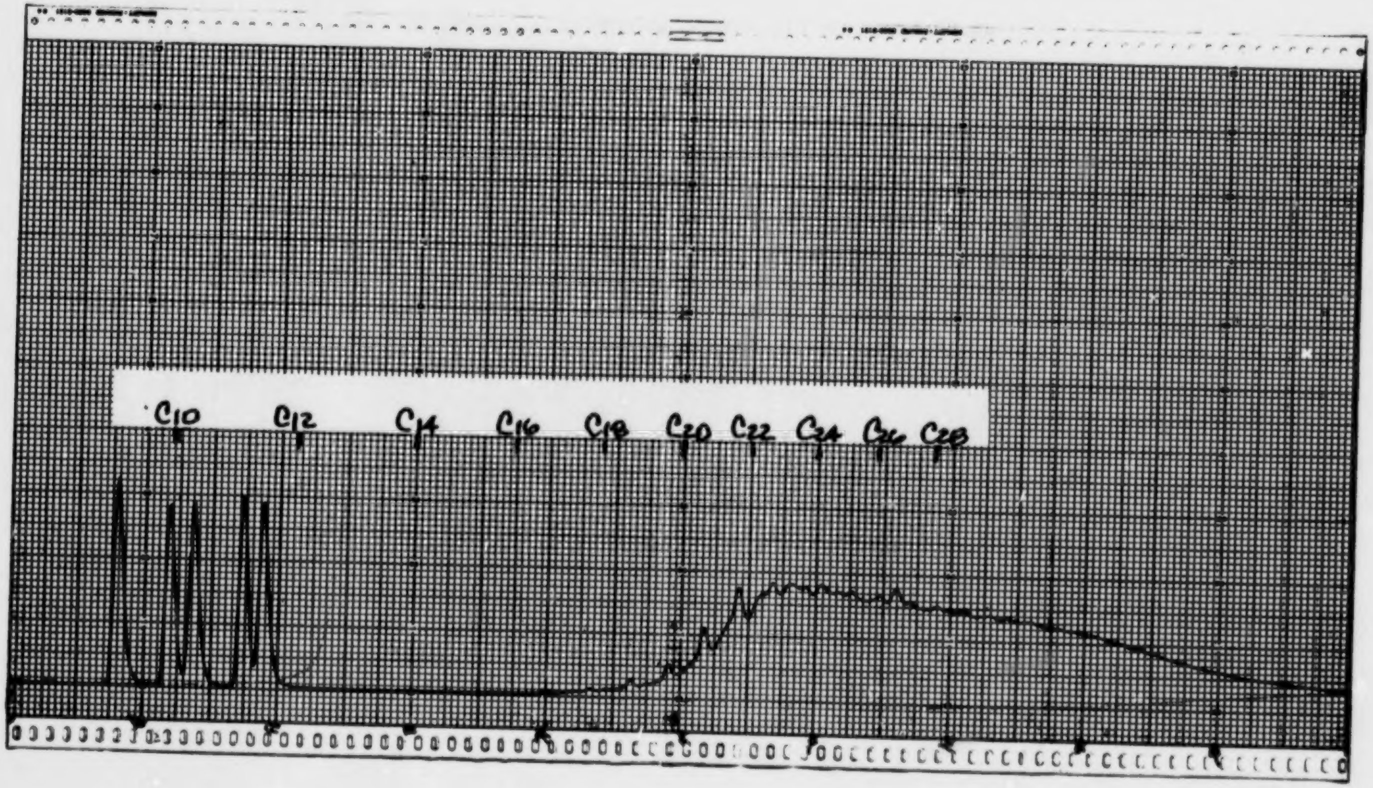

Figure O-2. Chromatogran of organic solubles from particulate matter, Fiat T.C. vehicle without exhaust aftertreatment operated on 4-bag FTP with EM-329-F fuel.

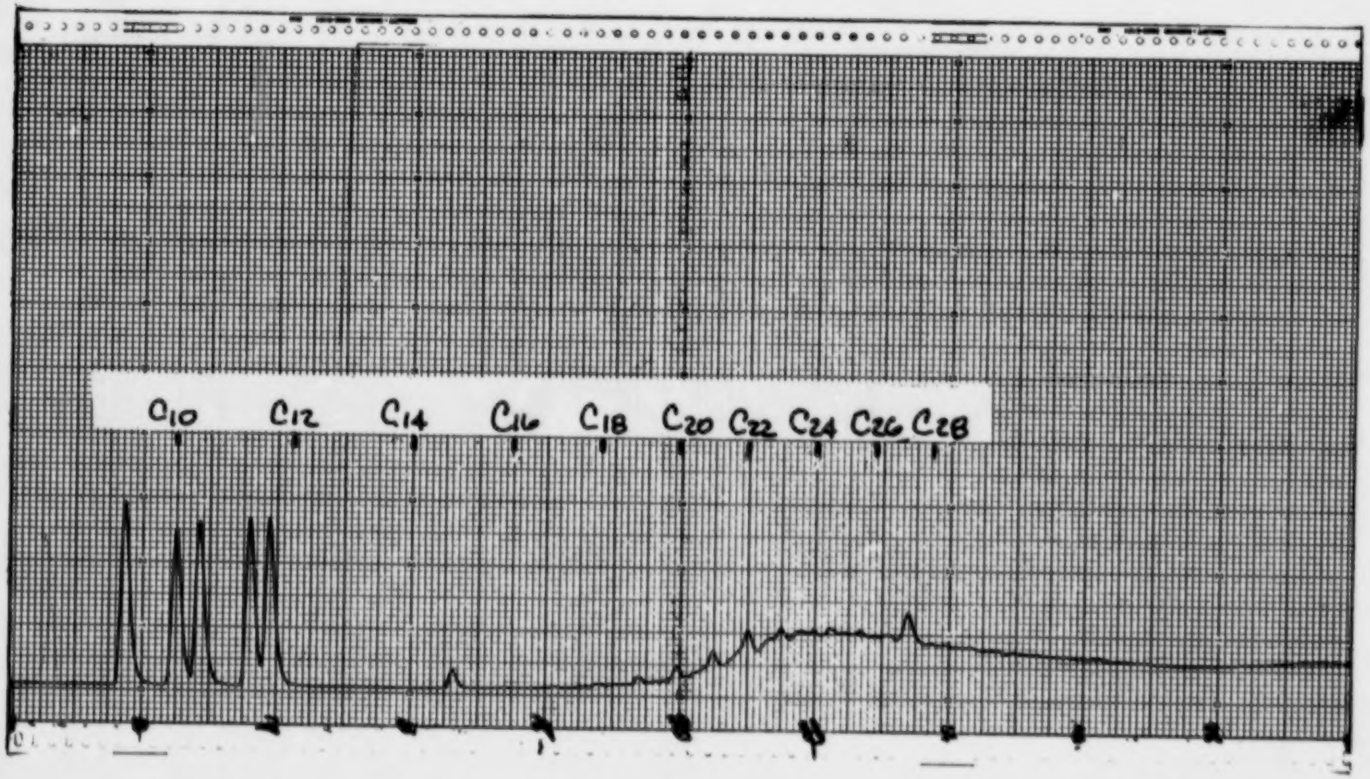

Figure O-3. Chromatogram of organic solubles from particulate matter, Fiat T.C. vehicle with catalytic trap operated on 4-bag FTP with EM-329-F fuel.

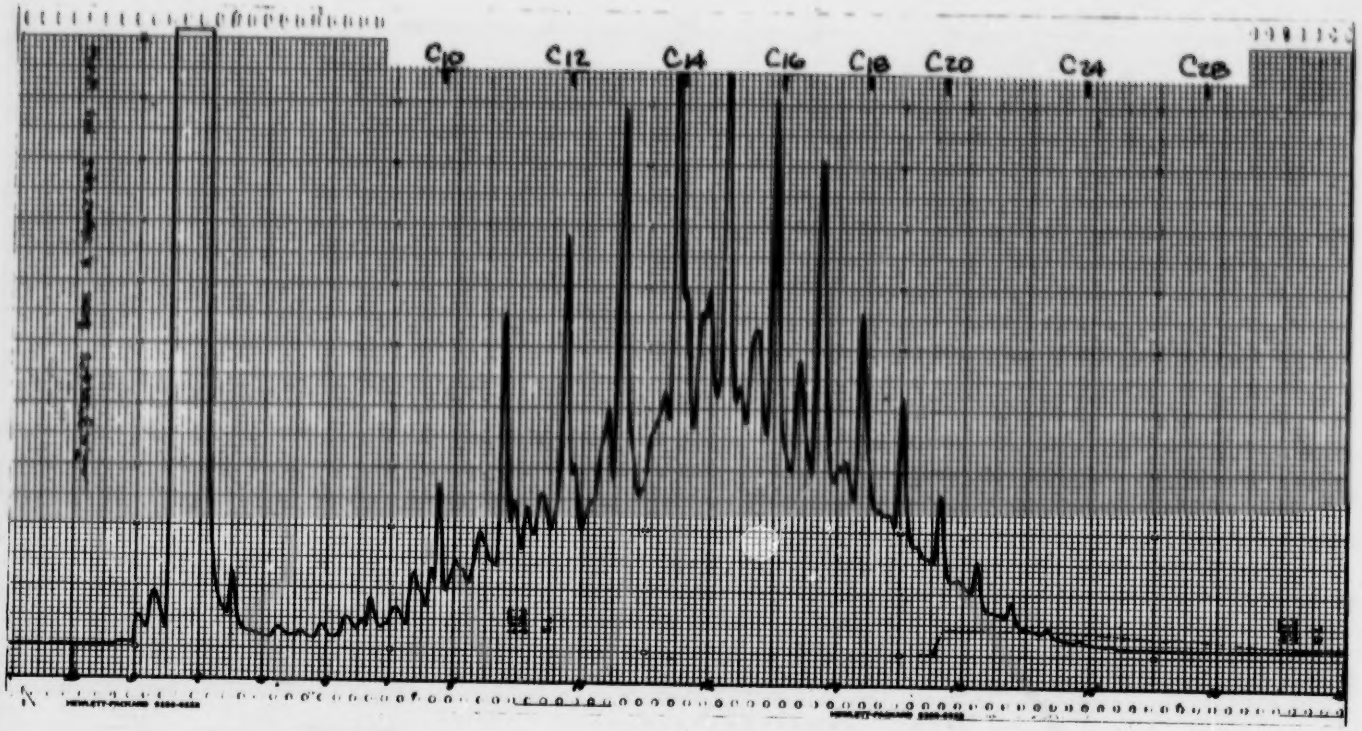

Figure O-4. Chromatogram of EM-329-F fuel.

APPENDIX P

FORMAL AMES BIOASSAY REPORTS
FIAT N.A., FIAT T.C., AND 1981 OLDSMOBILE CUTLASS DIESELS
FUELS EM-329-F AND EM-469-F

SOUTHWEST FOUNDATION FOR RESEARCH AND EDUCATION
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April 10, 1981

Final Report

1A329

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Naturally Aspirated Fiat w/o a Catalyst using EM-329-f Fuel

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were identified as 4874-1 filters no. 24 and 25 with a weight of 0.709 g, 4874-2 filter no. 21 with a weight of 0.450 g, 4874-3 filter no. 22 with a weight of 0.0464 g, and 4874-4 filter no. 35 with a weight of 0.573 g. An aroclor 1254-stimulated, rat liver homogenate metabolic activation system (S-9 mix) was included in sample 4874-1 filters no. 24 and 25 using tester strains TA 98, TA 1535, and TA 1538. In addition, the same sample was tested in the absence of a metabolic activation system using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples no. 4874-2 filter no. 21, 4874-3 filter no. 22, and 4874-4 filter no. 35 were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1,000 µg/plate. Each sample concentration was tested in triplicate plates with and without a metabolic activation and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within expected optimum ranges. Finally, an identical repeat of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without a metabolic activation system clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample 4874-1 filters 24 and 25 showed a negative mutagenic response using tester strain TA 1535 when exposed to the seven sample concentrations in the absence of an S-9 mix. TA 1537 minus S-9 mix shows an almost linear mutagenic response progressively up to a sample concentration of 400 µg/plate. TA 1538 minus S-9 mix illustrates a higher mutagenic response when treated with the same sample concentration. TA 98 minus S-9 mix shows an even higher mutagenic response with a slope of 0.79 which is four times greater than the slope for TA 1537.

In the presence of a metabolic activation system, sample 4874-1 filters 24 and 25 shows a weak mutagenic response on tester strain TA 1535. However, the same sample with S-9 mix at identical chemical concentrations produced strong mutagenic responses on TA 1538 and TA 98 with slopes of 0.87 and 1.05, respectively.

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TABLE 1. AMES BIOASSAY (INITIAL) OF NATURALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose (μg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	25	25	24	25	7	11	7	8	15	8	6	10	25	20	20	22
Media Control		Yes	11	22	18	17					15	16	11	14	30	28	37	32
Solvent Control (filter blank)		No	24	23	19	22	11	15	15	14	24	24	26	25	41	45	41	42
Positive Controls																		
NaN_3	0.5	No	293	277	285	285												
9AA	50	No					148	146	132	142								
2NF	5	No									1825	1824	1803	1817	1984	1744	1891	1873
2AA	3	Yes	268	292	319	293					380	382	304	355	2652	2687	2695	2678
Sample 1, P20-24 & 25	20	No	20	20	24	21	13	12	7	11	28	26	17	24	36	38	34	36
	60	No	16	24	19	20	13	14	13	13	39	43	34	39	56	59	63	59
	100	No	25	30	26	27	17	23	26	22	46	60	66	57	93	86	88	89
	200	No	15	27	18	20	37	56	40	44	118	100	90	103	142	128	146	139
	400	No	24	27	24	25	94	76	78	83	227	237	212	225	351	332	329	337
	600	No	21	23	18	21	146	152	127	142[b]	264	287	237	263[b]	475	412	423	437[b]
	1000	No	33	25	27	28	189	190	161	180[b]	291	290	240	274[b]	542	501	472	505[b]
Revertants/μg extract[a]						0.00				0.19				0.53				0.79
Sample 1, P20-24 & 25	20	Yes	8	11	8	9					36	34	16	29	57	60	37	51
	60	Yes	16	15	19	17					69	78	55	67	123	105	97	108
	100	Yes	19	15	17	17					92	90	94	92	122	115	95	111
	200	Yes	18	23	17	19					160	203	149	171	238	222	239	233
	400	Yes	29	9	17	18					380	340	366	362	493	482	447	474
	600	Yes	44	35	41	40					475	429	469	458[b]	657	684	601	647
	1000	Yes	66	59	57	61					551	610	649	603[b]	954	902	936	931[b]
Revertants/μg extract[a]						0.05								0.87				1.05

---

[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

Table 2 shows the results obtained from the other three samples tested using TA 98 in the absence of an S-9 mix. In the initial bioassay sample 4874-2 filter 21 illustrates an almost linear mutagenic response with a resulting slope of 0.77 revertants/µg extract. Sample 4874-3 filter 22 shows a slightly higher mutagenic response than the previous sample. Finally, sample 4874-4 filter 35 shows the lesser mutagenic response than the other two samples tested on TA 98.

Table 3 and Table 2 show the results of the complete identical repeat of the four samples tested in the bioassay. The repeated positive and negative controls almost conclusively duplicate the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 1. In the repeat study without S-9 mix, TA 1535 showed a negative response to sample no. 4874-1 filters 24 and 25 which is in agreement with the results obtained in the initial study. TA 1537 minus S-9 mix shows a resulting slope of 0.15 which is similar to slope of 0.19 obtained earlier in the initial study. TA 1538 shows a lesser mutagenic response to sample 4874-1 filters 24 and 25 in the repeat study as compared to the initial assay; however, TA 98 in the repeat study shows an average number of 347 revertants at a sample concentration of 400 µg/plate and in the initial study under identical sample concentrations TA 98 showed an average number of 337 revertants.

In the presence of a metabolic activation system the above sample results compared favorably with the results obtained from the initial bioassay. In the repeat study TA 1535 shows a slope of 0.04 which is in agreement with a slope of 0.05 of the initial assay. TA 1538 illustrates a slope of 0.83 as compared to a slope of 0.87 obtained in the initial bioassay and finally, TA 98 shows a slope of 1.00 as compared to a slope of 1.05 of the initial study.

Table 2 shows the results of the initial and repeat studies on sample 4874-2 filter 21, 4874-3 filter 22, and 4874-4 filter 35 using tester strain TA 98 in the absence of a metabolic activation system. The data in Table 2 clearly illustrate the reproducibility of results. Sample 4874-2 filter 21 shows a slope of 0.77 in both the initial and the repeat study. Sample 4874-3 filter 22 shows a slope of 0.86 and 0.90. The last sample, 4874-4 filter 35 shows a slope of 0.39 and a slope of 0.44 in the repeat study.

TABLE 2. AMES BIOASSAY (INITIAL & REPEAT WITHOUT S-9) OF NATURALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING HFET, NYCC, AND 85 KPH

Dose, (μg)/plate	Metabolic Activation, S-9	TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
		Sample 2, P20-21				Sample 3, P20-22				Sample 4, P20-35			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial[c]													
20	No	28	33	34	32	29	28	27	28	21	18	20	20
60	No	45	58	48	50	66	66	60	64	38	42	51	44
100	No	77	67	61	68	68	72	81	74	36	57	45	46
200	No	175	168	166	170	194	178	172	181	67	87	73	76
400	No	321	289	259	290	345	337	386	356	166	161	141	156
600	No	468	515	458	480	538	493	524	518	248	254	252	251
1000	No	681	725	600	669[b]	709	754	703	722[b]	437	412	391	413[b]
Revertants/μg extract[a]					0.77				0.86				0.39
Repeat[d]													
20	No	32	38	28	33	20	23	27	23	21	12	22	18
60	No	44	34	43	40	52	57	59	56	26	31	24	27
100	No	70	65	64	66	62	57	68	62	45	41	42	43
200	No	167	196	167	177	166	185	190	180	70	84	89	81
400	No	330	339	292	320	366	361	408	378	194	155	168	172
600	No	483	449	460	464	514	557	514	528	290	273	238	267
1000	No	781	770	672	741[b]	763	735	690	729[b]	481	408	366	418[b]
Revertants/μg extract[a]					0.77				0.90				0.44

---

[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

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TABLE 3. AMES BIOAWWAY (REPEAT) OF NATRUALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose µg/ Plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	22	11	9	14	10	5	6	7	10	10	10	10	17	17	16	17
Media Control		Yes	16	7	11	11					7	8	11	9	20	27	23	23
Solvent Control (Filter Blank)		No	18	13	7	13	7	5	10	7	29	23	20	24	32	38	37	36
Positive Controls																		
NaN_3	0.5	No	253	268	254	258												
9AA	50	No					134	101	120	118								
2NF	5	No									1358	1400	1404	1387	1538	1621	1495	1551
2AA	3	Yes	314	287	317	306					938	862	1015	938	2189	2159	2145	2164
Sample 1, P20-24 & 25	20	No	13	9	11	11	7	10	12	10	20	12	13	15	38	21	24	28
	60	No	15	17	11	14	14	10	12	12	30	37	30	32	51	57	64	57
	100	No	12	14	15	14	16	18	16	17	51	37	35	41	91	101	72	88
	200	No	18	14	14	15	34	27	30	30	91	59	76	75	189	171	176	179
	400	No	13	13	12	13	78	57	65	67	97	125	136	119	331	325	385	347
	600	No	14	16	16	15	92	75	79	82[b]	205	174	185	188[b]	451	410	413	425[b]
	1000	No	15	15	11	14	178	132	133	148[b]	265	241	209	238[b]	452	436	425	438[b]
Revertants/µg extract[a]						0.00				0.15				0.27				0.85
Sample 1, P20-24 & 25	20	Yes	12	12	10	11					42	34	31	36	50	45	38	44
	60	Yes	13	8	12	11					69	61	54	61	78	64	71	71
	100	Yes	9	11	12	11					83	94	96	91	99	97	107	101
	200	Yes	22	13	12	16					166	167	175	169	212	217	233	221
	400	Yes	21	20	23	21					386	356	308	350	447	429	472	449
	600	Yes	30	32	33	32					970	471	471	471[b]	617	585	596	599
	1000	Yes	42	43	59	48					589	604	608	600[b]	845	847	831	841[b]
Revertants/µg extract[a]						0.04								0.83				1.00

---

[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

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April 10, 1981

Final Report

1A469

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Naturally aspirated Fiat w/o a Catalyst using EM-469-f Fuel

Submitted by:

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Principal Investigator
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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were identified as 4874-5 filters no. 51 and 52 with a weight of 0.593595 g, 4874-6 filter no. 53 with a weight of 0.375945 g, 4874-7 filter no. 54 with a weight of 0.073181 g, and 4874-8 filter no. 55 with a weight of 0.571060 g. A aroclor 1254-stimulated, rat liver homogenate metabolic activation system was included in sample 4874-5 filters no. 51 and 52 using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 4874-5 filters no. 51 and 52 was tested in the absence of a metabolic activation system using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples no. 4874-6 filter no. 53, 4874-7 filter no. 54, and 4874-8 filter no. 55 were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1,000 μg/plate. Each sample concentration was tested in triplicate plates with and without a metabolic activation and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within optimum ranges. Finally, an identical repeat of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without a metabolic activation system clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample 4874-5 filters 51 and 52 showed no mutagenicity on tester strain 1535 when exposed to the seven chemical concentrations in the absence of an S-9 mix. TA 1537 minus S-9 mix shows an almost linear increase in the number of revertants up to a chemical concentration of 600 μg/plate. At 1,000 μg/plate, toxicity is evident as the number of revertants begin to decline. TA 1538 minus S-9 mix illustrates a slope of 0.54 revertants/μg extract at chemical concentrations up to 400 μg/plate. At higher chemical concentrations toxicity is observed. TA 98 minus S-9 mix illustrates a strong mutagenic response as evident in the slope of 1.39 revertants/μg of extract.

In the presence of an activation system, TA 1535 shows a weak mutagenic response over its negative control background. TA 1538 and TA 98 in the presence of an S-9 mix show a strong mutagenic response as evident in their slopes of 1.30 and 1.48, respectively.

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TABLE 1. AMES BIOASSAY (INITIAL) OF NATURALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (μg)/ plate	Metabolic Activation S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	35	31	37	34	14	14	8	12	19	19	17	18	30	33	29	31
Media Control		Yes	12	12	20	15					21	16	18	18	52	48	47	49
Solvent Control (Filter Blank)		No	54	37	37	43	10	15	15	13	21	25	29	25	53	44	42	46
Positive Controls																		
NaN_3	0.5	No	351	365	363	360												
9AA	50	No					364	495	469	443								
2NF	5	No									2080	2044	1985	2036	2202	2080	2030	2104
2AA	3	Yes	441	415	423	426					559	778	662	666	2776	3056	2984	2939
Sample 5 P20-51 & 52	20	No	31	43	31	35	16	11	14	14	21	28	22	24	65	63	51	60
	60	No	40	28	45	38	24	30	23	26	47	66	45	53	80	88	87	85
	100	No	31	22	22	25	36	43	32	37	62	86	63	70	159	183	164	169
	200	No	26	30	28	28	76	62	55	64	144	149	144	146	342	352	315	336
	400	No	36	28	29	31	97	102	96	98	238	261	188	229	606	620	686	637
	600	No	32	42	25	33	203	179	145	176	250	288	202	247[b]	878	834	774	829
	1000	No	24	29	33	29	130	111	117	119[b]	227	240	215	227[b]	1075	1055	1049	1060[b]
Revertants/μg extract[a]						0.00				0.26				0.54				1.39
Sample 5 P20-51 & 52	20	Yes	25	21	11	19												
	60	Yes	18	17	19	18					55	63	70	63	67	69	82	73
	100	Yes	29	19	20	23					96	124	112	111	144	163	124	144
	200	Yes	34	37	31	34					175	199	185	186	253	232	224	236
	400	Yes	52	52	57	54					332	315	331	326	441	424	411	425
	600	Yes	66	62	65	64					581	560	517	553	815	719	723	752
	1000	Yes	78	79	83	80					707	678	645	677[b]	951	915	861	909
											747	768	768	761[b]	1291	1357	1214	1287[b]
Revertants/μg extract[a]						0.07								1.30				1.48

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[a] This value is the slope of the regression line based on various extract dose levels and does not identity response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

Table 2 shows the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 4874-6 filter no. 53 shows the highest mutagenic response of the three samples tested. At 600 µg/plate, there were an average of 746 revertants/plate with a given slope of 1.18 revertants/µg of extract. Sample 4874-7 filter no. 54 shows a lesser mutagenic response than the previous sample. Sample 4874-8 filter no. 55 shows an even lesser mutagenic response than the previous two samples, consequently showing a reduction in the slope of 0.61 revertants/µg extract.

Table 3 and Table 2 show the results of the complete identical repeat of the four samples tested in the bioassay. The repeated positive and negative controls almost conclusively duplicate the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 1. In the repeat study without S-9 mix, TA 1535 showed a negative response when exposed to sample no. 4874-5 filters no. 51 and 52 at seven different chemical levels. The same sample minus S-9 mix using TA 1537 showed a slope of 0.27 which is almost identical to a slope of 0.26 of the initial bioassay. The repeat study of the same sample using TA 1538 showed an average of 280 revertants/plate at a chemical concentration of 400 µg/plate which is similar to the results obtained from the initial study of 229 revertants/plate at the same chemical concentration. Finally, in the absence of the S-9 mix TA 98 shows the highest level of mutagenicity when exposed to sample 4874-5 filters 51 and 52.

In the presence of a metabolic activation system the above sample results compared favorably with the results of the initial bioassay. TA 1535 shows a slope of 0.07 as compared to 0.07 of the initial study. TA 1538 illustrates a slope of 1.11 as compared to 1.30 of the first study and finally, TA 98 shows a slope of 1.17 as compared to 1.48 of the initial study.

Table 2 shows the results of the initial and repeat bioassays on samples 4874-6 filter no. 53, 4874-7 filter no. 54, and 4874-8 filter no. 55 using tester strain TA 98 in the absence of a metabolic activation system. The repeat study confirms sample 4874-6 filter no. 53 as having the highest mutagenic response when compared to the other two samples. Sample 4874-7 filter no. 54 shows a slope of 0.87 revertants/µg extract in the repeat study which compares favorably with the slope of 0.85 for the initial bioassay. Finally, the lowest mutagenic response is illicited by sample 4874-8 filter no. 55 as evident in both the initial and repeat studies.

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TABLE 2. AMES BIOASSAY (INITIAL & REPEAT WITHOUT S-9) OF NATURALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING HFET, NYCC, AND 85 KPH

		TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
	Metabolic Activation,	Sample 6 , P20- 53				Sample 7 , P20- 54				Sample 8, P20-55			
Dose, (μg)/plate	S-9	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial[c]													
20	No	77	74	70	74	48	48	37	44	45	41	35	40
60	No	140	115	127	127	71	82	78	77	67	62	58	62
100	No	132	128	149	136	80	91	88	86	89	81	84	85
200	No	393	394	356	381	172	195	204	190	132	131	132	132
400	No	629	500	492	540	414	395	339	383	292	292	254	279
600	No	767	747	724	746	529	549	487	522	380	409	378	389
1000	No	1055	1124	980	1053[b]	748	797	710	752[b]	563	575	556	565[b]
Revertants/μg extract[a]					1.18				0.85				0.61
Repeat[d]													
20	No	69	51	53	58	44	35	41	40	43	38	31	37
60	No	92	94	102	96	59	79	59	66	47	47	48	47
100	No	152	123	122	132	96	93	91	93	64	54	60	59
200	No	251	239	267	252	188	165	157	170	97	89	89	92
400	No	420	457	459	445	363	414	328	368	200	184	183	189
600	No	653	631	606	630	524	537	545	535	303	298	264	288
1000	No	918	967	913	933[b]	794	743	719	752[b]	493	446	472	470[b]
Revertants/μg extract[a]					1.00				0.87				0.44

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1 .

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3 .

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TABLE 3. AMES BIOASSAY (REPEAT) OF NATURALLY-ASPIRATED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	27	32	30	30	10	9	9	9	14	13	12	13	23	26	17	22
Media Control		Yes	19	20	25	21					16	18	25	20	35	41	34	37
Solvent Control (Filter Blank)		No	28	35	26	30	10	15	8	11	15	18	26	20	34	40	35	36
Positive Controls																		
NaN$_3$	0.5	No	300	266	267	278												
9AA	50	No					802	839	758	800								
2NF	5	No									2149	2045	2031	2075	2200	2110	1846	2052
2AA	3	Yes	353	368	395	372					1046	1046	1071	1054	2665	2825	2790	2760
Sample 5 P20-51 & 52	20	No	33	26	25	28	18	20	17	18	46	31	20	32	58	64	46	56
	60	No	34	28	14	25	28	29	27	28	60	48	56	55	80	84	78	81
	100	No	25	15	26	22	27	29	32	29	80	76	78	78	98	110	115	108
	200	No	23	24	32	26	61	55	58	58	143	132	160	145	278	268	249	265
	400	No	25	30	23	26	131	159	136	142	257	309	273	280	440	457	470	456
	600	No	27	25	23	25	166	156	161	161	327	315	342	328[b]	538	539	543	540[b]
	1000	No	29	26	22	26	149	159	107	138[b]	363	308	365	345[b]	529	562	555	549[b]
Revertants/µg extract[a]						0.00				0.27				0.66				1.10
Sample 5 P20-51 & 52	20	Yes	27	12	19	19					67	48	55	57	59	50	56	55
	60	Yes	19	15	17	17					91	76	86	84	87	84	71	81
	100	Yes	17	21	22	20					154	153	154	154	143	120	135	133
	200	Yes	27	30	24	27					303	291	278	291	266	279	252	266
	400	Yes	49	34	46	43					470	451	487	469	497	472	494	488
	600	Yes	79	69	68	72					627	590	613	610[b]	675	698	627	667[b]
	1000	Yes	89	82	70	80					775	788	795	786[b]	995	951	942	963[b]
Revertants/µg extract[a]						0.07								1.11				1.17

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[a] This value is the slope of the regression line based on various extract dose levels and does not identity response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

SOUTHWEST FOUNDATION FOR RESEARCH AND EDUCATION
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Final Report

1B329

In Vitro Ames Salmonella/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Naturally Aspirated Fiat with Catalytic Trap using EM-329-F Fuel

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on June 1, 1981, and were identified as Cycle FTP sample $9^{(a)}$ vial 418 with a weight of 0.168596 g, HFET sample 10 vial 420 with a weight of 0.037859 g, NYCC sample 11 vial 421 with a weight of 0.025536 g, and 85 kph sample 12 vial 422 with a weight of 0.036737 g. A range-finding study was conducted on sample $9^{(a)}$ utilizing tester strain TA 98 in the absence of a metabolic activation system (S-9 mix) to determine sample dosage on the initial and repeat bioassays. The range finding study incorporated the following sample dosages in µg/plate: 1, 10, 100, 500, 1000 and 2000. In the initial and repeat bioassays, an aroclor 1254-stimulated rat liver homogenate metabolic activation system was included in sample $9^{(a)}$ using tester strains TA 98, TA 1535, and TA 1538. In addition, the same sample was tested in the absence of a metabolic activation system using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 10, 11, and 12 were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) prior to testing. The initial and repeat bioassays were tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1,000 µg/plate. Each sample concentration was tested in triplicate plates with and without an S-9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within expected optimum ranges. Finally, an identical repeat of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

Results from the range-finding study (Table 1) indicated that the negative and positive controls are well within the expected optimum range. Sample 9(a) shows a positive mutagenic response to TA 98 in the absence of an S-9 mix. At sample concentrations of 1, 10, 100, and 500 µg/plate, TA 98 illustrates an almost linear mutagenic response with an average of 1,577 revertants at a sample concentrations of 500 µg/plate. At higher concentrations of 1000 and 2000 µg/plate the linear response is broken as the number of revertants begins to decline, indicating sample toxicity at high concentrations. Based on the results of the range-finding study, it was determined that the sample concentrations to be used in the initial and repeat bioassays would consist of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. These sample concentrations compare favorably with previous bioassays conducted on other samples received from the same project.

In the initial bioassay (Table 2), the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S-9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls.

Sample 9(a) showed a negative mutagenic response using tester strain TA 1535 when exposed to the seven sample levels in the absence of an S-9 mix. However, TA 1537 minus S-9 mix shows an almost linear mutagenic response up to a sample level of 400 µg/plate with a resulting slope of 1.43 revertants per µg of sample extract. TA 1538 minus S-9 mix shows a slightly higher mutagenic response with

TABLE 1. AMES BIOASSAY (RANGE-FINDING) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No																
Media Control		Yes													21	21		21
Solvent Control (Filter Blank)		No													26	20		23
Positive Controls																		
NaN$_3$	0.5	No																
9AA	50	No																
2NF	5	No																
2AA	3	Yes													2002	2047		2025
Sample 9	1	No																
	10	No													22	16		19
	100	No													40	47		44
	500	No													339	290		315
	1000	No													1541	1613		1577
	2000	No													2089	1998		2044[b]
		No													1866	1745[b]		1806[b]
Revertants/µg extract[a]																		
Sample	20	Yes																3.13
	60	Yes																
	100	Yes																
	200	Yes																
	400	Yes																
	600	Yes																
	1000	Yes																
Revertants/µg extract[a]																		

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

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TABLE 2. AMES BIOASSAY (INITIAL) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	14	15	19	16	15	12	11	13	12	8	14	11	39	37	20	32
Media Control		Yes	9	14	10	11					18	25	19	21	29	27	37	31
Solvent Control (Filter Blank)		No	21	18	13	17	13	9	10	11	16	15	19	17	19	32	28	26
Positive Controls																		
NaN_3	0.5	No	330	347	301	326												
9AA	50	No					703	516	449	556								
2NF	5	No									2166	2113	2002	2094	2186	2237	2255	2226
2AA	3	Yes	549	508	527	528					253	275	253	260	2485	2587	2723	2598
Sample 9	20	No	26	22	25	24	30	36	31	32	50	49	67	55	118	96	90	101
	60	No	31	20	19	26	76	79	97	84	133	160	134	142	227	275	263	255
	100	No	19	22	17	19	160	130	139	143	234	240	262	245	387	315	350	351
	200	No	24	30	27	27	310	286	315	304	394	381	428	401	780	793	863	812
	400	No	31	30	33	31	584	612	515	570	580	672	613	622[b]	1295	1421	1437	1384
	600	No	29	32	32	31	594	607	641	614[b]	487	484	532	501[b]	1601	1983	1534	1706[b]
	1000	No	20	8	10	13	333	385	399	372[b]	384	391	379	385[b]	1924	1943	2047	1971[b]
Revertants/µg extract[a]						0.00				1.43				1.91				3.42
Sample 9	20	Yes	22	10	14	15					61	53	63	59	77	73	63	71
	60	Yes	25	24	27	25					130	144	168	147	157	173	161	164
	100	Yes	18	25	25	23					193	196	192	194	221	250	241	237
	200	Yes	44	33	43	40					461	421	367	416	599	575	545	573
	400	Yes	44	53	42	46					732	862	813	802	1354	1196	1227	1259
	600	Yes	57	58	49	55					1146	1133	900	1060[b]	1756	1677	1666	1700[b]
	1000	Yes	42	41	43	42					984	1020	887	964[b]	2282	2225	2258	2255[b]
Revertants/µg extract[a]						0.03								1.96				3.18

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[a] This value is the slope of the regression line based on various dose levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

an average of 401 revertants at a sample level of 200 µg/plate and a resulting slope of 1.91 revertants/µg of sample extract. TA 98 minus S-9 mix shows an even higher mutagenic response with a slope of 3.42.

In the presence of a metabolic activation system, sample 9(a) shows a weak mutagenic response on tester strain TA 1535. However, the same sample with S-9 mix at identical chemical concentrations produced strong mutagenic responses on TA 1538 and TA 98 with slopes of 1.96 and 3.18, respectively.

Table 3 shows the results obtained from the other three samples tested using TA 98 in the absence of an S-9 mix. In the initial bioassay, sample No. 10-HFET illustrated a strong mutagenic response at the lowest level of 20 µg/plate with a resulting average of 469 revertants present per plate. At 60 µg/plate, there was an average of 1,173 revertants present per plate. At 100 µg/plate there was an average of 1,729 revertants present per plate. The resulting slope was 15.75 revertants present per µg of sample, which illustrates a strong mutagenic response. Sample 11-NYCC shows a resulting slope of 5.59 and sample 12-85 kph shows a resulting slope of 12.64 revertants/µg of sample extract.

Table 4 and Table 3 show the results of the complete identical repeat of the four samples tested in the bioassay. The repeated positive and negative controls almost conclusively duplicate the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 2.

In the repeat study minus S-9 mix, TA 1535 showed a negative response to sample 9a which parallels the results obtained in the initial study. TA 1537 minus S-9 mix shows a resulting slope of 1.49 which is similar to the slope of

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TABLE 3. AMES BIOASSAY (INITIAL AND REPEAT WITHOUT S-9) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES WITH EM-329-F BASE FUEL DURING HFET, NYCC, AND 85 KPH

		TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
	Metabolic Activation,	Sample 10				Sample 11				Sample 12			
Dose, (μg)/plate	S-9	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial[c]													
20	No	482	481	445	469	142	154	184	160	525	498	537	520
60	No	1198	1190	1132	1173	496	471	427	465	1131	1061	1107	1100
100	No	1633	1759	1796	1729	618	627	576	607	1460	1543	1591	1531
200	No	2315	2306	2320	2314[b]	1131	1010	1152	1098[b]	2217	2313	2305	2245[b]
400	No	2588	2746	2891	2742[b]	1608	1809	1683	1700[b]	2707	2824	2752	2761[b]
600	No	2685	2851	2821	2786[b]	1724	1785	1751	1753[b]	2918	2748	2828	2831[b]
1000	No	2839	2889	2826	2851[b]	1967	2072	2224	2088[b]	2817	2850	2910	2859[b]
Revertants/μg extract[a]					15.75				5.59				12.64
Repeat[d]													
20	No	323	398	385	370	122	127	126	125	432	459	455	449
60	No	988	978	953	973	318	305	340	321	917	1061	900	959
100	No	1253	1372	1356	1327	489	495	468	484	1250	1236	1392	1293
200	No	2049	2093	2172	2105[b]	916	927	977	940[b]	1938	2135	2034	2036[b]
400	No	2516	2464	2590	2523[b]	1227	1201	1321	1250[b]	2436	2543	2502	2494[b]
600	No	2529	2412	2617	2519[b]	1304	1328	1443	1358[b]	2459	2657	2618	2578[b]
1000	No	2704	2751	2734	2730[b]	1716	1679	1810	1735[b]	2583	2603	2408	2531[b]
Revertants/μg extract[a]					11.96				4.49				10.55

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[a] This value is the slope of the regression line based on various extract does levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in the slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 2.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 4.

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TABLE 4. AMES BIOASSAY (REPEAT) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose (μg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	28	20	21	23	10	13	10	11	10	13	7	10	26	27	22	25
Media Control		Yes	17	19	16	17					17	16	10	14	27	39	41	36
Solvent Control (Filter Blank)		No	18	22	23	21	6	12	19	12	17	19	10	15	20	25	32	26
Positive Controls																		
NaN_3	0.5	No	378	407	383	389												
9AA	50	No					615	651	673	646								
2NF	5	No									2419	2385	2153	2319	2290	2237	2487	2338
2AA	3	Yes	522	492	454	489					339	467	462	423	2178	2408	2265	2284
Sample 9	20	No	17	27	27	24	37	32	36	35	47	43	59	50	65	62	85	71
	60	No	33	34	25	31	89	82	86	86	133	160	162	152	268	222	275	255
	100	No	26	19	27	24	157	168	164	163	216	237	225	226	368	422	560	450
	200	No	35	23	22	27	390	357	320	356	494	482	519	498	989	1015	1041	1015
	400	No	26	37	27	30	584	588	597	590	669	687	644	667^b	1538	1594	1564	1565
	600	No	19	18	18	18	619	661	714	665^b	370	355	374	366^b	1813	1755	1807	1792^b
	1000	No	19	18	15	17	514	521	539	525^b	417	407	383	402^b	2072	2002	2055	2043^b
Revertants/μg extract^a						0.00				1.49				2.48				3.98
Sample 9	20	Yes	16	10	17	14					54	67	72	64	85	84	70	80
	60	Yes	13	14	21	16					178	167	208	184	186	161	152	166
	100	Yes	18	20	18	19					255	229	257	247	265	284	273	274
	200	Yes	32	34	30	32					548	549	501	533	633	590	576	600
	400	Yes	41	45	48	45					746	824	770	780	1180	1110	1108	1133
	600	Yes	68	61	61	63					1060	1041	994	1032^b	1586	1576	1702	1621^b
	1000	Yes	43	47	41	44					981	1001	944	975^b	2068	1810	1903	1927^b
Revertants/μg extract^a						0.04								1.88				2.82

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[a] This value is the slope of the regression line based on various dose levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

1.43 obtained earlier in the initial bioassay. TA 1538 and TA 98 showed a slightly higher mutagenic response in the repeat assay as compared to the initial study with resulting slopes of 2.48 and 3.98, respectively.

In the presence of a metabolic activation system, the above sample results compared favorably with the results obtained from the initial bioassay. In the repeat study TA 1535 shows a slope of 0.04 which is in agreement with the slope of 0.03 obtained in the initial bioassay. TA 1538 shows a slope of 1.88 as compared to the slope of 1.96 obtained in the initial study. TA 98 illustrates a slope of 2.82 as compared to the slope of 3.18 obtained in the initial study.

Table 3 shows the results obtained from the initial and repeat study on sample 10-HFET, sample 11-NYCC and sample 12-85 kph. Both initial and repeat studies compare favorably. Sample 10-HFET shows a slope of 15.75 on the first study followed by a slope of 11.96 on the repeat bioassay. Sample 11-NYCC illustrates a slope of 5.59 on the initial study as compared to 4.49 of the repeat study. Finally, sample 12-85 kph shows a slope of 12.64 on the first bioassay as compared to 10.55 of the repeat study. In summary, Table 3 illustrates the strong mutagenic responses of the above three samples in the absence of an S-9 mix.

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Final Report

1B469

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Naturally Aspirated Fiat NA/Catalytic Trap using Fuel EM-469-F

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on June 11, 1981, and were identified as sample 13 vial 453 with a weight of 0.141085 g, sample 14 vial 392 with a weight of 0.033589 g, sample 15 vial 454 with a weight of 0.033431 g, and sample 16 vial 407 with a weight of 0.033096 g. An aroclor 1254-stimulated rat liver homogenate metabolic activation system (S-9 mix) was included in sample 13 vial 453 using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 13 vial 453 was tested in the absence of an S-9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 14 vial 392, 15 vial 454, and 16 vial 407 were tested using tester strain TA 98 in the absence of a metabolic activation system.

A range-finding study was not conducted on the above samples because a previous bioassay had been conducted on the same automotive configuration using fuel EM-329-F. All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate plates with and without an S-9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within optimum ranges. Finally, an identical repeat of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S-9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample No. 13 vial 453 showed a negative mutagenic response on tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S-9 mix. At the higher chemical concentration of 1000 µg/plate, toxicity was prevalent as the bacterial lawn was inhibited. TA 1537 minus S-9 mix illustrated a positive mutagenic response showing an almost linear response up to a chemical concentration of 400 µg/plate with a resulting slope of 2.04 revertants per µg of sample extract. TA 1538 minus S-9 mix showed a slightly higher mutagenic response than TA 1537. At 400 µg/plate, there was an average of 917 revertants per plate. The resulting slope was 2.32 revertants/µg of sample extract. In the absence of S-9 mix, TA 98 illustrated the highest mutagenic response on the above sample. At 200 µg/plate there was an average of 913 revertants per plate with a resulting slope at 4.50 revertants/µg of sample extract.

In the presence of an activation system, the same sample illustrated a negative mutagenic response on tester strain TA 1535. However, mutagenicity was observed in tester strains TA 1538 and TA 98. At 200 µg/plate, TA 1538 responded with an average of 494 revertants/plate with a resulting slope of 2.39. TA 98 shows the highest mutagenic response to the sample with an average of 1,442

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TABLE 1. AMES BIOASSAY (INITIAL) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose, µg/ Plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	23	29	23	25	12	7	9	9	10	10	15	12	24	29	21	25
Media Control		Yes	10	19	11	13					16	11	16	14	29	39	37	35
Solvent Control (Filter Blank)		No	29	25	39	31	12	9	11	11	11	13	10	11	25	29	20	25
Positive Controls																		
NaN$_3$	0.5	No	406	336	353	365												
9AA	50	No					490	541	522	518								
2NF	5	No									1444	1654	1745	1631	1838	1825	1822	1828
2AA	3	Yes	353	435	365	384					600	948	568	705	2552	2447	2419	2473
Sample 13	20	No	18	26	21	22	27	44	23	31	48	43	60	50	82	89	99	90
	60	No	26	22	36	28	74	66	91	77	134	166	134	145	344	315	305	321
	100	No	29	19	26	25	165	187	156	169	287	293	228	269	501	557	562	540
	200	No	24	28	27	26	471	448	447	455	623	603	592	606	884	940	911	913
	400	No	22	26	22	23	749	773	812	778	917	979	855	917	1578	1591	1523	1564[b]
	600	No	15	17	16	16	873	774	864	837[b]	745	669	755	723[b]	1941	1808	1865	1871[b]
	1000	No	Toxicity				438	536	581	518[b]	424	412	476	437[b]	2148	1998	2164	2103[b]
Revertants/µg extract[a]						0.00				2.04				2.32				4.50
Sample 13	20	Yes	22	17	12	17					75	66	62	67	81	56	73	70
	60	Yes	13	20	27	20					152	151	170	158	186	155	157	166
	100	Yes	34	21	26	27					312	301	279	297	287	309	315	304
	200	Yes	41	48	34	41					460	492	529	494	745	732	702	726
	400	Yes	87	60	64	70					837	898	864	866[b]	1489	1430	1407	1442
	600	Yes	56	53	41	50					1198	1139	1215	1184[b]	1992	2017	1843	1967[b]
	1000	Yes	16	21	17	18					1080	945	952	992[b]	2553	2492	2461	2502[b]
Revertants/µg extract[a]						0.00								2.39				3.70

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[a] This value is the slope of the regression line based on various dose levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

revertants per plate at a sample concentration of 400 µg/plate. The resulting slope was 3.70 revertants per µg of sample extract.

Table 2 shows the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 14 vial 392 illustrated a strong mutagenic response in the absence of an S-9 mix. At 200 µg/plate TA 98 showed an average of 2,319 revertants per plate with a resulting slope of 10.63 revertants/µg of sample extract. Sample 15 vial 454 illustrated a slope of 3.88 revertants per µg of sample extract with an average of 838 revertants at a sample concentration of 200 µg/plate. The last sample in the initial bioassay illustrated a strong mutagenic response. Sample 16 vial 407 in the absence of S-9 mix showed an average of 2,315 revertants at a sample concentration of 200 µg/plate with a resulting slope of 10.36 revertants/µg of sample extract.

Table 3 and Table 2 show the results of the complete identical repeat of the four samples tested in the bioassay. The repeated positive and negative controls almost duplicate the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 1. The spontaneous mutation rate for TA 98 in the repeat bioassay was higher than the initial study; however, the positive controls illustrate the ability of TA 98 to revert upon exposure to a known mutagen. In the repeat study minus an S-9 mix, TA 1535 showed a negative response when exposed to sample No. 13 vial 453. At the highest sample concentration of 1,000 µg/plate, toxicity was observed in the repeat study as it was in the initial bioassay. TA 1537 minus S-9 showed a positive mutagenic response with a resulting slope of 1.67 in the repeat study as compared to 2.04 in the initial bioassay. The same sample minus S-9 mix using TA 1538 showed a slope of

TABLE 2. AMES BIOASSAY (INITIAL AND REPEAT WITHOUT S-9) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES WITH EM-469-F FUEL DURING HFET, NYCC, AND 85 KPH

Dose, μg/ Plate	Metabolic Activation, S-9	TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
		Sample 14				Sample 15				Sample 16			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial[c]													
20	No	368	395	402	394	122	117	126	122	361	369	402	377
60	No	912	875	861	883	382	313	328	341	1030	1044	1041	1038
100	No	1419	1408	1387	1431	500	483	497	493	1443	1407	1361	1404
200	No	2418	2242	2296	2319	885	815	814	838	2354	2140	2451	2315
400	No	2993	2867	2853	2904[b]	1473	1371	1521	1455[b]	2655	2694	2852	2734[b]
600	No	3023	3060	3038	3040[b]	1673	1835	1712	1740[b]	2983	3070	2906	2986[b]
1000	No	2823	2827	2983	2870[b]	1902	1684	2059	1882[b]	2930	2943	2973	2949[b]
Revertants/μg extract[a]					10.63				3.88				10.36
Repeat[d]													
20	No	416	368	405	396	97	72	73	81	·398	427	439	421
60	No	943	865	899	902	416	450	418	928	1057	1073	1003	1044
100	No	1496	1435	1392	1441	471	475	491	479	1290	1270	1548	1369
200	No	2310	2275	2318	2301	719	771	771	754	2036	1913	1814	1921
400	No	2939	2890	2960	2930[b]	1473	1530	1443	1482[b]	2512	2445	2522	2493[b]
600	No	3087	3025	2983	3032[b]	1721	1679	1733	1711[b]	2848	2880	2836	2857[b]
1000	No	3044	3063	3062	3056[b]	1709	1809	1912	1810[b]	3061	2999	2978	3013[b]
Revertants/μg extract[a]					10.48				3.38				7.85

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in the slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1 .

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

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TABLE 3. AMES BIOASSAY (REPEAT) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose, µg/ Plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	20	27	33	27	17	10	11	13	11	8	12	10	128	93	86	102
Media Control		Yes	11	12	10	11					13	21	17	17	94	118	116	109
Solvent Control (Filter Blank)		No	24	21	19	21	12	9	13	11	18	18	8	15	93	83	103	93
Positive Controls																		
NaN$_3$	0.5	No	385	402	402	396												
9AA	50	No					734	815	608	719								
2NF	5	No									2135	2037	1992	2055	2083	2137	2231	2150
2AA	3	Yes	467	349	371	396					262	226	288	259	2562	2774	2704	2680
Sample 13	20	No	17	29	30	25	24	31	29	28	51	49	33	44	183	165	171	173
	60	No	17	25	31	24	86	91	80	86	133	129	137	133	409	371	365	382
	100	No	22	24	15	20	179	149	126	151	217	235	212	221	575	593	585	584
	200	No	25	27	26	26	430	357	364	384	514	494	491	500	1235	1239	1228	1234
	400	No	21	25	11	19	720	616	606	647	854	825	748	809	1893	1943	2033	1956^b
	600	No	22	21	19	21	702	664	859	742^b	485	516	662	554^b	2083	2099	1880	2021^b
	1000	No	Toxicity				458	451	453	454^b	241	291	221	251^b	2032	2088	2136	2085^b
Revertants/µg extract[a]						0.00				1.67				2.04				5.93
Sample 13	20	Yes	15	19	14	16					65	63	63	64	156	171	139	155
	60	Yes	31	26	12	23					170	182	171	174	311	305	266	294
	100	Yes	29	26	26	27					308	348	291	316	493	471	470	478
	200	Yes	56	49	45	50					646	666	607	640	891	966	913	923
	400	Yes	49	68	52	56					1067	1085	1060	1071^b	1695	1800	1773	1756
	600	Yes	38	35	32	35					1327	1237	1217	1260^b	2249	2270	2315	2278^b
	1000	Yes	6	8	11	8					937	878	774	863^b	2632	2630	2530	2597^b
Revertants/µg extract[a]						0.00								3.23				4.26

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[a] This value is the slope of the regression line based on various dose levels and does not identify response at a particular extract dose since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

2.04 in the repeat study which is almost identical to the slope of 2.32 of the initial bioassay. In the repeat study, TA 98 elicited a strong mutagenic response to sample 13 vial 453 in the absence of an S-9 mix. A resulting slope of 5.93 revertants/µg of sample extract was obtained in the repeat study using TA 98 as compared to a slope of 4.50 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated an identical negative response to sample 13 vial 453 in the repeat study as compared to initial bioassay. TA 1538 in the presence of an S-9 mix showed a strong mutagenic response to sample 13 vial 453 as was observed earlier in the initial bioassay. In addition, TA 98 illustrated a strong mutagenic response to sample 13 vial 453 in the presence of an S-9 mix. The resulting slope was 4.26 in the repeat study as compared to 3.70 in the initial bioassay.

Table 2 shows the results of the initial and repeat bioassays on samples No. 14 vial 392, 15 vial 454, and 16 vial 407 using tester strain TA 98 in the absence of a metabolic activation system. The repeat study illustrates that sample 14 vial 392 has the highest mutagenic response when compared to the other two samples. Sample 15 vial 454 shows a slope of 3.38 in the repeat study which compares favorably with the slope of 3.88 obtained in the inital bioassay. Finally, sample 16 vial 407 shows a strong mutagenic response with a resulting slope of 7.85 as compared to a slope of 10.36 obtained in the initial bioassay.

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Final Report
2A329

In Vitro Ames *Salmonella* Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from an Oldsmobile Cutlass Diesel using EM-329-F Fuel

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Introduction

Southwest Foundation for Research and Education Genetic Toxicology Laboratory examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on June 25, 1981, and were identified as sample 17 (vial 481) with a weight of 0.150515 g, sample 18 (vial 415) with a weight of 0.082663 g, sample 19 (vial 416) with a weight of 0.024751 g, and sample 20 (vial 417) with a weight of 0.117650 g. An aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included with sample 17 (vial 481) using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 17 (vial 481) was tested in the absence of an S9 mix using tester strains TA98, TA 1535, TA 1537, and TA 1538. Samples No. 18 (vial 415), 19 (vial 416), and 20 (vial 417) were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1,000 µg/plate. Each sample concentration was tested in triplicate plates with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within expected optimum ranges. Finally, duplicate bioassay of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without a metabolic activation system clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample 17 (vial 481) showed a negative mutagenic response using tester strain TA 1535 when exposed to the seven sample concentrations in the absence of an S9 mix. TA 1537 minus S9 mix shows an almost linear mutagenic response progressively up to a sample level of 200 μg/plate. The resulting slope is of 0.81 revertants/μg. TA 1538 minus S9 mix illustrates a higher mutagenic response when treated with the same sample concentration. The resulting slope is 1.55 revertants/μg. TA 98 minus S9 mix shows an even greater mutagenic response with a slope of 3.3 revertants/μg which is four times greater than the slope for TA 1537.

In the presence of a metabolic activation system, sample 17 (vial 481) shows a weak mutagenic response on tester strain TA 1535. However, the same sample with S9 mix at identical chemical concentrations produced mutagenic responses in TA 1538 and TA 98 with slopes of 1.56 and 2.20 respectively. In TA 1538, the slope for the sample was identical to that obtained without metabolic activation whereas the slope obtained with TA 98 was lower in the presence of S9.

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TABLE 1. AMES BIOASSAY (INITIAL) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	21	19	14	18	9	5	11	8	13	13	11	12	22	20	20	21
Media Control		Yes	14	9	12	12					20	24	20	21	29	21	32	27
Solvent Control (Filter Blank)		No	20	21	22	21	11	12	10	11	12	15	16	14	28	28	24	27
Positive Controls																		
NaN$_3$	0.5	No	486	480	468	478												
9AA	50	No					551	546	510	536								
2NF	5	No									2536	2295	2215	2349	2658	2557	2561	2592
2AA	3	Yes	666	628	695	663					219	223	215	219	2908	2421	2432	2587
Sample 17 P20-137 & 138	20	No	23	14	21	19	22	20	21	21	27	41	34	34	51	46	47	48
	60	No	21	21	16	19	55	46	54	52	80	72	69	74	170	163	157	163
	100	No	12	16	17	15	94	76	84	85	157	168	149	158	291	321	324	312
	200	No	18	20	20	19	181	172	144	166	199	197	176	191[b]	492	538	453	494[b]
	400	No	19	17	21	19	232	240	257	243[b]	278	223	267	256[b]	937	878	853	889[b]
	600	No	5	6	5	5	202	201	213	205[b]	149	153	144	149[b]	696	656	683	678[b]
	1000	No		Toxicity				Toxicity				Toxicity				Toxicity		
Revertants/µg extract[a]						-0.02				0.81				1.55				3.30
Sample 17 P20-137 & 138	20	Yes	21	17	14	17					44	43	58	48	59	75	64	66
	60	Yes	14	14	13	14					117	96	131	115	121	142	128	130
	100	Yes	24	26	23	24					216	179	201	199	261	284	266	270
	200	Yes	29	36	26	30					343	325	320	329	536	446	455	479
	400	Yes	45	49	54	49					584	583	576	581[b]	956	899	832	896
	600	Yes	60	51	58	56					823	836	750	803[b]	1319	1268	1253	1280[b]
	1000	Yes	61	57	40	53					845	776	723	781[b]	1684	1495	1517	1565[b]
Revertants/µg extract[a]						0.04								1.56				2.20

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

Table 2 shows the results obtained from the other three samples tested using TA 98 in the absence of an S9 mix. In the initial bioassay sample 18 (vial 415) illustrates an almost linear mutagenic response with a resulting slope of 4.85 revertants/μg extract. Toxicity was observed at levels greater than 200 μg/plate. Sample 19 (vial 416) shows a lower mutagenic response than the previous sample, with a slope of 2.32 revertants/μg. Finally, sample 20 (vial 417) shows an intermediate mutagenic response compared to the other two samples tested on TA 98 with a slope of 3.18 revertants/μg. In the repeat study, slightly lower values were obtained, but the relative ranking remained the same.

The duplicate positive and negative controls specific for each tester strain are given in Table 3. In the repeat study without S9 mix, TA 1535 showed a negative response to sample 17 (vial 481) which is in agreement with the results obtained in the initial study. TA 1537 minus S9 mix shows a resulting slope of 0.61 compared to slope of 0.81 obtained in the initial study. TA 1538 shows a lesser mutagenic response to sample 17 (vial 481) in the repeat study compared to the initial assay. The resulting slope is 1.23 revertants/μg in the repeat study compared to 1.55 in the initial bioassay. In the repeat study, the mutagenicity in TA 98 was slightly lower than in the initial study. Under identical sample concentrations TA 98 showed an average slope of 2.94 revertants/μg compared to 3.3 initially.

In the presence of a metabolic activation system the above sample results compared favorably with the results obtained from the initial bioassay. In the repeat study TA 1535 shows a slope of 0.06 revertants/μg which is in agreement with a slope of 0.04 in the initial bioassay. TA 1538 illustrates a slope of 1.24 compared to a slope of 1.56 obtained in the initial bioassay and finally, TA 98 shows a slope of 1.74 as compared to a slope of 2.20 in the initial bioassay.

TABLE 2. AMES BIOASSAY (INITIAL & REPEAT WITHOUT S-9) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F DURING HFET, NYCC, AND 85 KPH

		TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
	Metabolic Activation,	Sample 18, P20-139				Sample 19, P20-140				Sample 20, P20-141			
Dose (μg)/plate	S-9	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Initial[c]													
20	No	203	209	195	202	46	31	43	40	96	94	92	94
60	No	421	354	382	386	141	115	129	128	249	265	233	249
100	No	664	653	593	637	252	226	214	231	482	448	433	454
200	No	1109	1058	1042	1070	476	417	472	455	770	808	723	767
400	No	1671	1603	1576	1617[b]	824	827	877	843[b]	1231	1381	1344	1319
600	No	1828	1894	1833	1852[b]	1060	1028	981	1023[b]	1339	1404	1400	1381[b]
1000	No	1797	1812	1730	1780[b]	1275	1101	1104	1160[b]	1567	1378	1170	1372[b]
Revertants, μg extract[a]					4.85				2.32				3.18
Repeat[d]													
20	No	98	120	117	112	32	33	34	33	52	68	78	66
60	No	267	291	263	274	106	103	103	104	172	146	168	162
100	No	447	437	497	460	146	182	152	160	312	310	315	312
200	No	861	850	810	840	312	366	332	337	544	568	512	541
400	No	1447	1443	1370	1420[b]	661	671	616	649[b]	1030	1054	951	1012
600	No	1653	1617	1632	1634[b]	888	888	880	885[b]	1229	1204	1158	1197[b]
1000	No	1680	1708	1724	1704[b]	1188	1214	1153	1185[b]	1303	1459	1424	1395[b]
Revertants, μg extract[a]					4.05				1.68				2.48

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

TABLE 3. AMES BIOASSAY (REPEAT) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	29	31	24	28	10	7	9	9	11	15	14	13	27	24	21	24
Media Control		Yes	14	14	17	15					20	18	23	20	37	32	31	33
Solvent Control (Filter Blank)		No	30	25	25	27	8	4	8	7	15	10	14	13	32	30	30	31
Positive Controls																		
NaN3	0.5	No	453	474	495	474												
9AA	50	No					653	631	550	611								
2NF	5	No									2524	2472	2331	2442	2319	2297	2341	2319
2AA	3	Yes	585	561	613	586					583	692	510	595	2724	2838	2920	2827
Sample 17 P20-137 & 138	20	No	29	22	18	23	27	18	17	21	41	30	25	32	54	58	52	55
	60	No	22	15	27	21	32	45	44	40	78	88	77	81	97	114	150	120
	100	No	24	21	24	23	73	84	62	73	141	118	131	130	281	310	280	290
	200	No	13	26	29	23	143	123	120	129	178	165	182	175[b]	495	485	451	477[b]
	400	No	19	17	24	20	144	175	159	159[b]	225	224	274	241[b]	731	839	783	784[b]
	600	No		Toxicity			90	61	98	83[b]	137	156	159	151[b]	807	825	925	852[b]
	1000	No		Toxicity				Toxicity				Toxicity			659	560	653	624[b]
Revertants/µg extract[a]						-0.01				0.61				1.23				2.94
Sample 17 P20-137 & 138	20	Yes	9	10	15	11					47	34	46	42	48	62	69	60
	60	Yes	14	14	14	14					81	82	80	81	121	119	129	123
	100	Yes	29	33	27	30					146	162	156	155	185	179	184	183
	200	Yes	28	32	32	31					263	268	251	261	353	355	342	350
	400	Yes	52	41	54	49					421	512	427	453[b]	768	667	718	718
	600	Yes	58	53	54	55					673	670	632	658[b]	1019	886	904	936[b]
	1000	Yes	61	66	77	68					757	736	691	728[b]	1213	1152	1151	1172[b]
Revertants/µg extract[a]						0.06								1.24				1.74

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

In summary, sample 17 (vial 481) is nonmutagenic in TA 1535 without metabolic activation and only weakly mutagenic in the presence of S9. No increase in mutagenic activity was observed in TA 1538 with metabolic activation, but without metabolic activation the activity was greater than that observed in TA 1537. The highest activity was observed in TA 98 without metabolic activation and this activity decreased in the presence of S9. The relative mutagenicity of the other samples in TA 98 without metabolic activation is sample 18 (vial 415) > sample 20 (vial 417) > sample 19 (vial 416).

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Final Report
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In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a 1981 Oldsmobile Cutlass Diesel using Fuel EM-469-F

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on August 8, 1981, and were identified as sample 21 (vial 526) with a weight of 0.170525 g, sample 22 (vial 512) with a weight of 0.093687 g, sample 23 (vial 602) with a weight of 0.027680 g, and sample 24 (vial 513) with a weight of 0.128568 g. An Aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included in sample 21 (vial 526) using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 21 (vial 526) was tested in the absence of an S9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 22 (vial 512), 23 (vial 602), and 24 (vial 513) were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to demonstrate that the system was working well within optimum ranges. Finally, a duplicate bioassay of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample No. 21 (vial 526) showed a negative mutagenic response on tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S9 mix. Toxicity was observed at levels greater than 200 µg/plate. TA 1537 minus S9 mix illustrated a positive mutagenic response showing an almost linear response up to a chemical concentration of 200 µg/plate with a resulting slope of 0.96 revertants per µg of sample extract. Toxicity was observed at levels greater than 200 µg/plate. TA 1538 minus S9 mix showed a greater mutagenic response than TA 1537. At 100 µg/plate, there was an average of 183 revertants/-plate. The resulting slope was 1.71 revertants/µg of sample extract. Toxicity was observed at higher levels of extract. In the absence of S9 mix, TA 98 demonstrated the greatest mutagenic response on the above sample. At 400 µg/plate there was an average of 1336 revertants/plate with a resulting slope of 3.18 revertants/µg of sample extract.

In the presence of an activation system, the same sample illustrated a very weak mutagenic response on tester strain TA 1535. Mutagenicity was observed in tester strains TA 1538 and TA 98. At 200 µg/plate, TA 1538 responded with an average of 490 revertants/plate with a resulting slope of 2.27. TA 98 exhibited

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TABLE 1. AMES BIOASSAY (INITIAL) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	19	16	17	17	23	8	13	15	13	10	15	13	23	16	19	19
Media Control		Yes	17	10	12	13					21	8	25	18	31	34	39	35
Solvent Control (Filter Blank)		No	20	17	22	20	12	6	20	13	15	14	13	14	20	24	24	23
Positive Controls																		
NaN_3	0.5	No	390	390	329	370												
9AA	50	No					1043	723	643	803								
2NF	5	No									2485	2372	2514	2457	2476	2498	2554	2509
2AA	3	Yes	453	444	439	445					1761	1666	1543	1657	1873	2277	2074	2075
Sample 21	20	No	18	19	19	19	38	34	34	35	41	49	47	46	77	71	59	69
P20-101 & 102	60	No	18	22	26	22	75	70	47	64	161	159	123	148	278	289	281	283
	100	No	23	19	20	21	95	113	100	103	187	176	186	183	556	493	536	528
	200	No	22	23	10	18	203	214	197	205	190	235	217	214[b]	762	801	741	768
	400	No		Toxicity			137	170	212	173[b]		Toxicity			1413	1369	1227	1336
	600	No		Toxicity				Toxicity				Toxicity			1316	1434	1510	1420[b]
	1000	No		Toxicity				Toxicity				Toxicity			1256	1367	1391	1338[b]
Revertants/µg extract[a]						-0.01				0.96				1.71				3.18
Sample 21	20	Yes	15	13	12	13					76	80	90	82	70	93	105	89
P20-101 & 102	60	Yes	29	11	27	22					187	164	167	173	207	174	196	192
	100	Yes	30	32	34	32					301	263	303	289	396	342	411	383
	200	Yes	35	47	41	41					555	495	420	490	799	743	644	729
	400	Yes	62	70	62	65					897	847	845	863[b]	1472	1305	1346	1374
	600	Yes	69	49	49	56					1002	1030	990	1007[b]	1784	1719	1632	1712[b]
	1000	Yes	30	38	39	36					904	798	731	811[b]	2151	2108	2004	2088[b]
Revertants/µg extract[a]						0.02								2.27				3.42

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

an increased mutagenic response to the sample when S9 was employed with an average of 1374 revertants/plate at a sample concentration of 400 µg/plate. The resulting slope was 3.42 revertants/µg of sample extract. The S9 fraction appeared to protect the TA 98 strain from toxicity observed without an activation system.

Table 2 illustrates the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 22 (vial 512) illustrated a fairly strong mutagenic response in the absence of an S9 mix. At 100 µg/plate TA 98 showed an average of 819 revertants/plate with a resulting slope of 6.21 revertants/µg of sample extract. Sample 23 (vial 602) had a slope of 3.36 revertants/µg of sample extract with an average of 663 revertants at a sample concentration of 200 µg/plate. Sample 24 (vial 513) in the absence of S9 mix showed an average of 1035 revertants at a sample concentration of 200 µg/plate with a resulting slope of 4.76 revertants/µg of sample extract.

Table 2 also shows the results of the repeat bioassays on samples No. 22 (vial 512), 23 (vial 602), and 24 (vial 513) using tester strain TA 98 in the absence of a metabolic activation system. The repeat study of sample 24 (vial 513) demonstrated the highest mutagenic response when compared to the other two samples. Sample 23 (vial 602) exhibits the lowest mutagenicity of these samples with a slope of 2.55 in the repeat study which compares favorably with the slope of 3.36 obtained in the inital bioassay. Finally, sample 22 (vial 512) shows an intermediate mutagenic response in the repeat bioassay with a resulting slope of 3.38 as compared to a slope of 6.21 obtained in the initial bioassay. Lower values were obtained with sample 22 (vial 512) and sample 23 (vial 602) in the

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TABLE 2. AMES BIOASSAY (INITIAL & REPEAT WITHOUT S-9) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F DURING HFET, NYCC, AND 85 KPH

Dose (μg)/plate	Metabolic Activation, S-9	TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
		Sample 22, P20-183				Sample 23, P20-Various				Sample 24, P20-185			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Initial^c													
20	No	299	364	303	322	67	69	65	67	182	179	173	178
60	No	517	480	477	491	174	162	170	169	380	366	364	370
100	No	911	795	750	819	301	288	273	287	594	596	541	577
200	No	1342	1320	1252	1305^b	645	697	646	663	1100	1049	956	1035
400	No	1940	1942	1930	1937^b	1019	1087	1083	1063^b	1605	1567	1464	1545^b
600	No	2112	1982	2046	2047^b	1216	1190	1112	1173^b	1955	2044	1861	1953^b
1000	No	2070	2107	2119	2099^b	1353	1275	1393	1340^b	1868	1969	1993	1943^b
Revertants, μg extract^a					6.21				3.36				4.76
Repeat^d													
20	No	265	279	281	275	62	66	63	64	138	137	170	148
60	No	381	399	412	397	187	171	146	168	350	328	276	318
100	No	558	560	493	537	284	240	273	266	510	518	540	523
200	No	715	694	721	710^b	525	532	515	524	1031	992	917	980
400	No	2018	1982	1938	1979^b	867	923	837	876^b	1474	1438	1445	1452^b
600	No	2293	2212	2159	2221^b	1086	1036	1112	1078^b	1811	1808	1611	1743^b
1000	No	2109	2107	2073	2096^b	853	976	1046	958^b	1733	1640	1488	1620^b
Revertants, μg extract^a					3.28				2.55				4.65

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

repeat assay but sample 24 (vial 513) was nearly identical. Toxicity was observed in all samples at levels greater then 200 µg/plate and in sample 22 (vial 512) at levels greater than 100 µg/plate.

Table 3 demonstrates the results of the duplicate bioassay of the four samples tested. The positive and negative controls nearly duplicated the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 1. However, a reduced number of mutants was observed with 2-aminoanthracene in the repeat bioassay. The spontaneous mutation rate for TA 98 in the repeat bioassay was greater than in the initial study; however, the positive controls illustrate the ability of TA 98 to revert upon exposure to a known mutagen, 2-nitrofluorene. In the repeat bioassay minus an S9 mix, TA 1535 showed a weakly positive response when exposed to sample No. 21 (vial 526). At a sample concentration of 400 µg/plate, toxicity was observed in the repeat study as it was in the initial bioassay, although less toxicity was observed in the repeat study. The slope for sample 21 (vial 526) in TA 1537, 1.21 was somewhat greater than that obtained in the initial bioassay, 0.96. The same sample minus S9 mix using TA 1538 demonstrated a slope of 2.16 in the repeat study which is greater then the slope of 1.76 in the initial bioassay. In the repeat study, TA 98 elicited the greatest mutagenic response to sample 21 (vial 526) in the absence of an S9 mix. A resulting slope of 3.30 revertants/µg of sample extract was obtained in the repeat study using TA 98 as compared to a slope of 3.18 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated a nearly identical weak response to sample 21 (vial 526) in the repeat study as

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TABLE 3. AMES BIOASSAY (REPEAT) OF 1981 OLDSMOBILE CUTLASS DIESEL EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	20	28	28	25	18	19	12	16	19	20	21	20	38	52	20	37
Media Control		Yes	18	15	21	18					29	30	31	30	40	38	44	41
Solvent Control (Filter Blank)		No	26	28	24	26	11	26	11	16	10	19	25	18	36	27	35	33
Positive Controls																		
NaN_3	0.5	No	405	368	443	405												
9AA	50	No					1152	1191	1153	1165								
2NF	5	No									2732	2644	2813	2730	2515	2739	2499	2584
2AA	3	Yes	266	258	274	266					492	453	465	470	407	470	504	460
Sample 21 P20-181 & 182	20	No	22	18	21	20	36	33	37	35	62	65	57	61	83	79	94	85
	60	No	29	30	24	28	83	80	84	82	133	144	133	137	215	245	236	232
	100	No	36	33	30	33	140	121	132	131	237	240	225	234	557	505	541	534
	200	No	38	33	31	34	264	265	229	253	383	339	316	346[b]	825	880	903	869
	400	No	24	24	34	27[b]	332	313	307	317[b]	237	264	264	255[b]	1341	1387	1329	1352
	600	No	20	29	24	24[b]		Toxicity				Toxicity			1473	1512	1444	1476[b]
	1000	No		Toxicity				Toxicity				Toxicity			1422	1548	1627	1532[b]
Revertants/µg extract[a]						0.07				1.21				2.16				3.30
Sample 21 P20-181 & 182	20	Yes	27	20	12	20					97	91	80	89	94	80	100	91
	60	Yes	29	33	27	30					193	188	192	191	185	236	208	210
	100	Yes	33	33	32	33					353	344	306	334	417	369	353	380
	200	Yes	61	67	51	60					520	497	541	519	793	730	731	751
	400	Yes	78	102	89	90					1029	941	981	984[b]	1365	1464	1305	1378
	600	Yes	91	102	92	95					1097	1120	1131	1116[b]	1541	1697	1680	1739[b]
	1000	Yes	55	67	57	60					1009	924	839	924[b]	2264	2115	2147	2175[b]
Revertants/µg extract[a]						0.05								2.39				3.41

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

compared to initial bioassay. TA 1538 in the presence of an S9 mix showed a slightly greater mutagenic response to sample 21 (vial 526) as was observed earlier in the initial bioassay. In addition, TA 98 exhibited the strongest mutagenic response to sample 21 (vial 526) in the presence of an S9 mix. The resulting slope was 3.41 in the repeat study as compared to 3.42 in the initial bioassay.

In summary, sample 21 (vial 526) was very weakly mutagenic in TA 1535 with or without activation, although the presence of S9 elevates the slope slightly over baseline. A positive response was obtained in strains TA 1537 (without activation), and TA 1538 and TA 98, with and without activation. In TA 1538 and in TA 98, S9 enhanced mutagenic activity. Samples 22 (vial 512), 23 (vial 602), and 24 (vial 513) were mutagenic in TA 98 without metabolic activation.

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Final Report
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In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Turbo-charged Diesel Fiat (No Catalyst) using Fuel EM-329-F

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on August 8, 1981, and were identified as sample 25 (vial 587) with a weight of 0.287070 g, sample 26 (vial 545) with a weight of 0.079832 g, sample 27 (vial 546) with a weight of 0.045799 g, and sample 28 (vial 547) with a weight of 0.093887 g. An aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included in sample 25 (vial 587) using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 25 (vial 587) was tested in the absence of an S9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 26 (vial 545), 27 (vial 546), and 28 (vial 547) were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate plates with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to illustrate that the system is working well within optimum ranges. Finally, an identical repeat of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample No. 25 (vial 587) showed a very weak mutagenic response on tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S9 mix. TA 1537 minus S9 mix illustrated a positive mutagenic response showing an almost linear response up to a chemical concentration of 600 µg/plate with a resulting slope of 0.757 revertants per µg of sample extract. TA 1538 minus S9 mix showed a slightly higher mutagenic response than TA 1537. At 400 µg/plate, there was an average of 421 revertants per plate. The resulting slope was 1.04 revertants/µg of sample extract. Toxicity was observed at 600 and 1000 µg/plate. In the absence of S9 mix, TA 98 illustrated the highest mutagenic response on the above sample. At 400 µg/plate there was an average of 1242 revertants per plate with a resulting slope at 3.17 revertants/µg of sample extract.

In the presence of an activation system, the same sample illustrated a very weak mutagenic response on tester strain TA 1535. Mutagenicity was observed in tester strains TA 1538 and TA 98. At 600 µg/plate, TA 1538 responded with an average of 900 revertants/plate with a resulting slope of 1.50. TA 98 exhibited a decreased mutagenic response to the sample when S9 was employed with an average of 1837 revertants per plate at a sample concentration of 1000 µg/plate. The

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TABLE 1. AMES BIOASSAY (INITIAL) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F FUEL DURING FTP

Sample Identification	Dose (μg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	17	17	23	19	5	5	9	6	7	10	16	11	23	19	15	19
Media Control		Yes	8	12	17	12					15	15	24	18	35	22	36	31
Solvent Control (Filter Blank)		No	15	24	21	20	5	5	6	5	14	19	16	16	26	28	31	28
Positive Controls																		
NaN$_3$	0.5	No	329	350	325	335												
9AA	50	No					344	446	505	433								
2NF	5	No									2315	2241	2366	2307	2332	2397	2198	2309
2AA	3	Yes	240	226	249	238					443	631	442	505	2943	2985	2900	2943
Sample 25 P20-197 & 198	20	No	20	20	21	20	12	14	20	15	44	30	41	38	55	55	62	57
	60	No	20	21	19	20	30	37	43	37	76	79	76	77	185	174	179	179
	100	No	15	19	22	19	62	53	55	57	128	124	128	127	261	252	254	256
	200	No	30	28	20	26	179	167	140	162	301	285	277	288	662	675	657	665
	400	No	19	21	30	23	318	326	300	315	431	405	428	421	1235	1249	1243	1242
	600	No	21	26	21	23	471	470	368	436	625	609	610	615[b]	1644	1538	1417	1533[b]
	1000	No	29	26	21	25	629	591	488	569[b]	625	665	594	628[b]	1836	1885	1826	1849[b]
Revertants/μg extract[a]						0.005				0.757				1.04				3.17
Sample 25 P20-197 & 198	20	Yes	11	8	13	11					73	55	66	65	70	80	62	75
	60	Yes	11	15	14	13					89	92	93	91	130	107	106	114
	100	Yes	11	17	22	17					149	156	145	150	160	151	148	153
	200	Yes	21	27	29	26					366	343	348	352	438	399	367	401
	400	Yes	43	41	42	42					627	666	686	660	942	939	886	922
	600	Yes	61	58	56	58					928	925	848	900	1266	1229	1190	1228
	1000	Yes	65	54	53	57					1307	1229	1171	1236[b]	1980	1889	1643	1837
Revertants/μg extract[a]						0.05								1.50				1.88

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

resulting slope was 1.88 revertants per µg of sample extract. The S9 fraction appeared to protect the TA 98 strain from toxicity observed without an activation system.

Table 2 shows the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 26 (vial 545) illustrated a mutagenic response in the absence of an S9 mix. At 600 µg/plate TA 98 showed an average of 1712 revertants per plate with a resulting slope of 2.93 revertants/µg of sample extract. Sample 27 (vial 546) illustrated a slope of 1.39 revertants per µg of sample extract with an average of 814 revertants at a sample concentration of 600 µg/plate. The last sample in the initial bioassay exhibited the strongest mutagenic response. Sample 28 (vial 547) in the absence of S9 mix showed an average of 1405 revertants at a sample concentration of 400 µg/plate with a resulting slope of 3.40 revertants/µg of sample extract.

Table 3 and Table 2 show the results of the replicate testing of the four samples tested in the bioassay. The repeated positive and negative controls nearly duplicated the revertant numbers specific for each tester strain as compared to the initial bioassay described in Table 1. The spontaneous mutation rate for TA 98 in the repeat bioassay was higher than the initial study; however, the positive controls illustrate the ability of TA 98 to revert upon exposure to a known mutagen. In the repeat study minus an S9 mix, TA 1535 showed a negative response when exposed to sample No. 25 (vial 587). At the highest sample concentration of 1,000 µg/plate, toxicity was observed in the repeat study as it was in the initial bioassay. The slope for sample 25 (vial 587) in TA 1537, 0.766, was nearly identical to that obtained in the initial bioassay, 0.757. The same

TABLE 2. AMES BIOASSAY (INITIAL AND REPEAT WITHOUT S-9) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F FUEL DURING HFET, NYCC, AND 85 KPH

Dose (μg)/plate	Metabolic Activation, S-9	TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
		Sample 26, P20-199				Sample 27, P20-200				Sample 28, P20-201			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Initial[c]													
20	No	78	60	80	73	52	44	66	54	127	100	123	117
60	No	172	193	214	193	78	91	92	87	260	286	264	270
100	No	314	326	325	322	187	155	175	172	395	368	404	389
200	No	646	682	652	660	325	337	319	327	851	815	724	797
400	No	1378	1315	1321	1338	632	671	694	666	1417	1399	1400	1405
600	No	1511	1838	1788	1712	815	833	794	814	1833	1850	1781	1821[b]
1000	No	2319	2260	2180	2253[b]	1131	1214	1111	1152[b]	1993	2109	1981	2028[b]
Revertants, μg extract[a]					2.93				1.39				3.40
Repeat[d]													
20	No	77	84	74	78	51	37	46	45	119	90	123	111
60	No	218	168	210	199	119	110	108	112	252	281	223	252
100	No	460	392	357	403	241	210	220	224	397	385	393	392
200	No	647	697	718	687	352	342	318	337	797	810	697	768
400	No	1430	1301	1417	1383	732	702	676	703	1471	1313	1308	1364
600	No	1790	1698	1462	1650	956	932	849	912	1743	1800	1720	1754[b]
1000	No	1950	2022	2115	2029[b]	1210	1262	1151	1208[b]	1992	1875	1815	1894[b]
Revertants, μg extract[a]					2.82				1.52				3.31

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

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TABLE 3. AMES BIOASSAY (REPEAT) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	31	25	33	30	16	13	13	14	21	14	20	18	28	40	31	33
Media Control		Yes	10	22	17	16					21	21	22	21	29	40	43	37
Solvent Control (Filter Blank)		No	23	26	31	27	8	13	8	10	9	21	24	18	27	38	30	32
Positive Controls																		
NaN3	0.5	No	238	220	254	237												
9AA	50	No					399	366	301	355								
2NF	5	No									2395	2483	2529	2469	2361	2473	2446	2447
2AA	3	Yes	436	384	432	417					1527	1418	1668	1538	2341	2644	2540	2508
Sample 25 P20- 197 & 198	20	No	32	29	33	31	20	22	21	21	39	54	38	44	79	66	54	66
	60	No	23	30	24	26	36	42	42	40	88	81	89	86	173	154	141	156
	100	No	24	28	30	27	71	54	58	61	93	115	107	105	288	263	240	264
	200	No	33	25	34	31	181	150	166	166	281	279	248	269	628	662	577	622
	400	No	23	25	29	26	356	368	302	342	442	432	442	439	1268	1112	1070	1150
	600	No	24	25	25	28	433	463	420	439	566	547	464	526[b]	1512	1326	1371	1006[b]
	1000	No	19	18	20	19	569	540	545	551[b]	556	545	528	543[b]	1761	1704	1711	1725[b]
Revertants/µg extract[a]						-0.008				0.766				1.07				2.92
Sample 25 P20- 197 & 198	20	Yes	20	17	29	22					72	58	59	63	75	77	64	72
	60	Yes	20	28	15	21					119	121	95	112	146	131	116	131
	100	Yes	18	17	19	18					173	156	146	158	175	138	138	150
	200	Yes	37	15	26	26					339	328	350	339	481	496	437	471
	400	Yes	38	43	41	41					688	602	583	624	929	821	858	869
	600	Yes	59	68	56	61					837	872	772	827	1187	1190	1150	1176
	1000	Yes	77	68	65	70					1177	1202	1145	1175[b]	1811	1755	1708	1758
Revertants/µg extract[a]						0.06								1.36				1.77

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

sample minus S9 mix using TA 1538 showed a slope of 1.07 in the repeat study which is almost identical to the slope of 1.04 of the initial bioassay. In the repeat study, TA 98 elicited the greatest mutagenic response to sample 25 (vial 587) in the absence of an S9 mix. A resulting slope of 2.92 revertants/µg of sample extract was obtained in the repeat study using TA 98 as compared to a slope of 3.17 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated an identical weak response to sample 25 (vial 587) in the repeat study as compared to initial bioassay. TA 1538 in the presence of an S9 mix showed a stronger mutagenic response to sample 25 (vial 587) as was observed earlier in the initial bioassay. In addition, TA 98 exhibited the strongest mutagenic response to sample 25 (vial 587) in the presence of an S9 mix, although this value was lower than that obtained without the S9 mix. The resulting slope was 1.77 in the repeat study as compared to 1.88 in the initial bioassay.

Table 2 shows the results of the initial and repeat bioassays on samples No. 26 (vial 545), 27 (vial 546), and 28 (vial 547) using tester strain TA 98 in the absence of a metabolic activation system. The repeat study illustrates that sample 28 (vial 547) has the highest mutagenic response when compared to the other two samples. Sample 27 (vial 546) shows the lowest mutagenicity of these samples with a slope of 1.52 in the repeat study which compares favorably with the slope of 1.39 obtained in the inital bioassay. Finally, sample 26 (vial 545) shows an intermediate mutagenic response with a resulting slope of 2.82 as compared to a slope of 2.93 obtained in the initial bioassay.

In summary, sample 25 (vial 587) was nonmutagenic in TA 1535 with or without activation, although the presence of S9 elevates the slope slightly over baseline. A positive response was obtained in strains TA 1537 (without activation), and TA 1538 and TA 98, without and without activation. In TA 1538, S9 enhances mutagenic activity, while in TA 98, the activity decreased with S9. Samples 26 (vial 545), 27 (vial 546), and 28 (vial 547) were mutagenic in TA 98 without metabolic activation. The relative activity obtained was sample 28 (vial 547) > sample 26 (vial 545) > sample 27 (vial 546).

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Final Report
3A469

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Fiat Turbocharged Diesel (no catalyst) using Fuel EM-469-F

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on August 20, 1981, and were identified as sample 29 (vial 630) with a weight of 0.411470 g, sample 30 (vial 594) with a weight of 0.100163 g, sample 31 (vial 579) with a weight of 0.045719 g, and sample 32 (vial 590) with a weight of 0.115647 g. An Aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included in sample 29 (vial 630) using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 29 (vial 630) was tested in the absence of an S9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 30 (vial 594), 31 (vial 579), and 32 (vial 590) were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to demonstrate that the system was working within optimum ranges. Finally, a duplicate bioassay of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

In the initial bioassay, the results indicate that the negative and positive controls are well within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure causing a significant increase in the number of revertants over the negative controls (Table 1).

Sample No. 29 (vial 630) showed a negative mutagenic response on tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S9 mix. TA 1537 minus S9 mix illustrated a positive mutagenic response showing an almost linear response up to a chemical concentration of 400 µg/plate with a resulting slope of 1.22 revertants/µg of sample extract. Toxicity was observed at levels greater than 400 µg/plate. TA 1538 minus S9 mix showed a greater mutagenic response than TA 1537. At 200 µg/plate, there was an average of 422 revertants/plate. The resulting slope was 2.14 revertants/µg of sample extract. Toxicity was observed at higher levels of extract. In the absence of S9 mix, TA 98 demonstrated the greatest mutagenic response on the above sample. At 200 µg/plate there was an average of 978 revertants/plate with a resulting slope of 5.0 revertants/µg of sample extract.

In the presence of an activation system, the same sample illustrated a very weak mutagenic response on tester strain TA 1535. Mutagenicity was observed in tester strains TA 1538 and TA 98. At 200 µg/plate, TA 1538 responded with an average of 509 revertants/plate with a resulting slope of 2.46. TA 98 exhibited a decreased mutagenic response to the sample when S9 was employed with an average

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TABLE 1. AMES BIOASSAY (INITIAL) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (µg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	19	18	21	19	14	9	5	9	14	9	9	11	17	10	15	14
Media Control		Yes	10	9	17	12					7	13	13	11	29	21	28	26
Solvent Control (Filter Blank)		No	16	15	17	16	8	8	9	8	10	10	12	11	21	14	14	20
Positive Controls																		
NaN$_3$	0.5	No	310	315	301	309												
9AA	50	No					678	771	831	762								
2NF	5	No									2435	2309	2345	2363	2382	2279	2505	2389
2AA	3	Yes	322	285	251	286					1717	1646	1587	1650	2323	2185	1965	2158
Sample 29 P20-225 & 226	20	No	7	8	10	8	31	29	26	29	43	34	32	36	83	93	84	87
	60	No	16	18	10	14	65	49	75	63	117	140	116	124	272	248	275	265
	100	No	14	15	21	17	87	104	103	98	222	196	193	204	525	498	524	516
	200	No	18	12	11	14	278	304	236	273	429	438	398	422	989	962	984	978
	400	No	11	10	9	10	472	434	525	477	606	566	609	594[b]	1515	1579	1548	1547[b]
	600	No	18	22	23	21	514	501	487	501[b]	581	595	560	579[b]	1957	1860	1863	1893[b]
	1000	No	14	10	16	13	409	441	446	432[b]	337	292	312	314[b]	2107	2213	2123	2148[b]
Revertants/µg extract[a]						0.00				1.22				2.14				5.00
Sample 29 P20-225 & 226	20	Yes	11	19	16	15					84	66	65	72	61	66	73	67
	60	Yes	18	13	8	13					129	157	168	151	173	140	145	153
	100	Yes	19	13	13	15					265	257	249	257	292	293	310	298
	200	Yes	39	34	32	35					539	496	492	509	794	742	702	746
	400	Yes	49	42	35	42					886	897	837	873[b]	1365	1313	1346	1341
	600	Yes	69	55	64	63					1217	1138	1061	1139[b]	1989	1796	1892	1892
	1000	Yes	51	46	55	51					1343	1304	1150	1266[b]	2472	2340	2269	2360[b]
Revertants/µg extract[a]						0.05								2.46				3.22

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

of 1341 revertants/plate at a sample concentration of 400 µg/plate. The resulting slope was 3.22 revertants/µg of sample extract. The S9 fraction appeared to protect the TA 98 strain from toxicity observed without an activation system.

Table 2 illustrates the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 30 (vial 594) illustrated a fairly strong mutagenic response in the absence of an S9 mix. At 200 µg/plate TA 98 showed an average of 1118 revertants/plate with a resulting slope of 5.34 revertants/µg of sample extract. Sample 31 (vial 579) had a slope of 1.07 revertants/µg of sample extract with an average of 449 revertants at a sample concentration of 400 µg/plate. Sample 32 (vial 590) in the absence of S9 mix showed an average of 1060 revertants at a sample concentration of 200 µg/plate with a resulting slope of 5.02 revertants/µg of sample extract.

Table 2 also shows the results of the repeat bioassays on samples 30 (vial 594), 31 (vial 579), and 32 (vial 590) using tester strain TA 98 in the absence of a metabolic activation system. The repeat study of sample 30 (vial 594) demonstrated the highest mutagenic response when compared to the other two samples with a slope of 5.11 revertants/µg compared to 5.34 in the initial bioassay. Sample 31 (vial 579) exhibits the lowest mutagenic response of these samples with a slope of 1.11 in the repeat study which compares favorably with the slope of 1.07 obtained in the inital bioassay. Finally, sample 32 (vial 590) demonstrated a mutagenic response slightly lower than sample 30 (vial 594) in the repeat bioassay with a resulting slope of 4.78 as compared to a slope of 5.02 obtained in the initial bioassay. Slightly lower values were obtained with sample 30 (vial 594) and sample 32 (vial 590) in the repeat bioassay but sample

TABLE 2. AMES BIOASSRY (INITIAL & REPEAT WITHOUT S-9) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING HFET, NYCC, AND 85 KPH

		TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
	Metabolic Activation,	Sample 30, P20-227				Sample 31, P20-228				Sample 32, P20- 229			
Dose (μg)/plate	S-9	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Initial[c]													
20	No	142	159	171	157	56	44	45	48	148	157	164	156
60	No	350	396	363	370	87	91	78	85	408	365	321	365
100	No	599	551	584	578	148	97	137	127	630	601	617	616
200	No	1118	1135	1101	1118	265	221	236	241	970	1100	1111	1060
400	No	1809	1956	1863	1876[b]	475	416	456	449	1659	1708	1730	1699[b]
600	No	2451	2253	2254	2319[b]	689	597	608	631[b]	2002	1837	2123	1987[b]
1000	No	2648	2556	2630	2611[b]	860	838	832	843[b]	2305	2329	2357	2330[b]
Revertants, μg extract[a]					5.34				1.07				5.02
Repeat[d]													
20	No	141	160	137	146	53	61	61	58	174	163	178	172
60	No	304	328	309	314	92	83	72	82	352	405	309	355
100	No	553	545	551	550	143	150	117	137	537	615	604	585
200	No	1059	1048	1056	1054	273	264	250	262	1057	994	1034	1028
400	No	1615	1566	1548	1576[b]	465	481	459	468	1680	1563	1511	1585[b]
600	No	2068	2036	1868	1991[b]	666	658	614	646[b]	1976	1985	1940	1967[b]
1000	No	2162	2420	2341	2308[b]	929	930	876	912[b]	1825	2094	2051	1990[b]
Revertants, μg extract[a]					5.11				1.11				4.78

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 1.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 3.

31 (vial 579) was nearly identical. Toxicity was observed in all samples at levels greater then 200 μg/plate.

Table 3 demonstrates the results of the duplicate bioassay of sample 29 (vial 630). The duplicate positive and negative controls are within experimental range for each tester strain as compared to the initial bioassay described in Table 1. However, a greater number of mutants was observed with 2-aminoanthracene in the repeat bioassay. In the repeat bioassay minus an S9 mix, TA 1535 again showed a negative mutagenic response when exposed to sample No. 29 (vial 630). At a sample concentration of 600 μg/plate, slightly less toxicity was observed in the repeat study. The slope for sample 29 (vial 630) in TA 1537, 1.12 was somewhat less than that obtained in the initial bioassay, 1.22. The same sample minus S9 mix using TA 1538 demonstrated a slope of 1.08 in the repeat study which is less than the slope of 2.14 in the initial bioassay. In the repeat study, TA 98 elicited the greatest mutagenic response to sample 29 (vial 630) in the absence of an S9 mix. A resulting slope of 4.26 revertants/μg of sample extract was obtained in the repeat study using TA 98 as compared to a slope of 5.0 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated a nearly identical weak response to sample 29 (vial 630) in the repeat study as compared to initial bioassay. TA 1538 in the presence of an S9 mix showed a mutagenic response to sample 29 (vial 630) that was nearly identical to that observed in the initial bioassay. In addition, TA 98 exhibited a decreased mutagenic response to sample 29 (vial 630) in the presence of an S9 mix. The resulting slope was 2.88 in the repeat study as compared to 3.22 in the initial bioassay.

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TABLE 3. AMES BIOASSAY (REPEAT) OF TURBOCHARGED FIAT DIESEL (NO CATALYST) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose (μg)/ plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Media Control		No	20	30	25	25	10	9	10	10	16	17	15	16	30	24	37	30
Media Control		Yes	21	15	12	16					23	22	22	22	37	33	37	36
Solvent Control (Filter Blank)		No	29	28	30	29	15	9	7	10	15	14	17	15	33	30	23	29
Positive Controls																		
NaN$_3$	0.5	No	490	495	516	500												
9AA	50	No					433	330	417	393								
2NF	5	No									2359	2399	2373	2377	2223	2265	1760	2083
2AA	3	Yes	288	320	251	286					208	183	181	191	2630	2828	2865	2774
Sample 29 P20- 225 & 226	20	No	23	29	23	25	30	21	30	27	55	47	50	51	69	55	46	57
	60	No	30	28	31	30	65	51	68	61	130	121	117	123	135	132	152	140
	100	No	16	25	25	22	119	149	119	129	268	252	223	248	246	220	279	248
	200	No	33	19	34	29	248	275	252	258	261	221	269	250	807	813	787	802
	400	No	23	27	33	28	450	476	416	447	286	308	379	324[b]	1242	1266	1137	1215[b]
	600	No	31	25	23	26	518	531	488	512[b]	287	325	268	293[b]	1515	1565	1522	1534[b]
	1000	No		Toxicity			405	366	388	386[b]	256	255	222	244[b]	1950	1979	2113	2014[b]
Revertants/μg extract[a]						0.00				1.12				1.08				4.26
Sample 29 P20- 225 & 226	20	Yes	18	13	13	15					61	81	63	68	86	87	76	83
	60	Yes	20	27	24	24					146	160	155	154	156	167	153	159
	100	Yes	27	20	23	23					280	223	274	259	299	297	298	298
	200	Yes	50	43	41	45					512	461	449	474	733	704	678	705
	400	Yes	59	64	59	61					835	801	798	811[b]	1231	1256	1226	1238
	600	Yes	78	77	67	74					1010	939	956	968[b]	1694	1723	1709	1709
	1000	Yes	68	79	56	68					954	944	879	926[b]	2276	2148	2177	2200[b]
Revertants/μg extract[a]						0.06								2.27				2.88

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

In summary, sample 29 (vial 630) was very weakly mutagenic in TA 1535 with metabolic activation; the absence of S9 reveals no mutagenic activity. A positive response was obtained in strains TA 1537 (without activation), and TA 1538 and TA 98, with and without activation. In TA 1538 but not in TA 98, S9 enhanced mutagenic activity. Samples 30 (vial 594), 31 (vial 579), and 32 (vial 590) were mutagenic in TA 98 without metabolic activation.

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Final Report

3B329

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Fiat Turbocharged Diesel (with underfloor catalytic trap) using Fuel EM-329-F

Submitted by:

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on October 3, 1981, and were identified as sample 33 (FTP 691) with a weight of 0.169580 g, sample 34 (HFET 698) with a weight of 0.026566 g, sample 35 (NYCC 704) with a weight of 0.027415 g, and sample 36 (85 kph 705) with a weight of 0.028934 g. An Aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included in sample 33 using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 33 was tested in the absence of an S9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 34, 35, and 36 were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to demonstrate that the system was working within optimum ranges. Finally, a duplicate bioassay of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

A range finding study was conducted on sample no. 33 in tester strains TA 98 and TA 1535. The range finding study as shown in Table 1 disclosed that sample no. 33 was reactive in tester strain TA 98, both with and without metabolic activation, although the reactivity was enhanced by the presence of metabolic activating enzymes. The sample was toxic to the tester organisms at 1000 μg/plate. Consequently, it was determined that an upper limit of 1000 μg/plate would be appropriate for definitive testing, and a range of concentrations from 20 to 1000 μg/plate was selected. In TA 1535, no mutagenicity was observed without metabolic activation. Using an S9 fraction for metabolic activation, increased mutagenic activity was observed. Again, toxicity was observed at 1000 μg/plate.

In the initial bioassay, the results indicate that the negative and positive controls are within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure, causing a significant increase in the number of revertants over the negative controls (Tables 2 and 4).

In Table 2, sample no. 33 showed a weak mutagenic response in tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S9 fraction. Toxicity was observed at 400 μg/plate, and the slope was 0.07 revertants/μg extract. TA 1537 minus S9 demonstrated a greater mutagenic response than TA 1535 with a resulting slope of 1.72 revertants/μg extract. Toxicity was also observed at levels above 200 μg/plate. TA 1538 minus S9 showed a greater mutagenic response than both TA 1537 and TA 1535. At 400 μg/plate, there was an average of 489 revertants/plate. The resulting slope was 2.60 revertants/μg of sample extract. Toxicity was observed at higher levels of extract. In the absence of S9 mix, TA 98 demonstrated the greatest mutagenic response to the above sample. At 400 μg/plate there was an average of 1947 revertants/plate with a resulting slope of 4.93 revertants/μg of sample extract.

In the presence of an activation system, decreased mutagenicity was observed for sample no. 33 in strains TA 1535, TA 1538, and TA 98. Sample no. 33 illustrated a very weak mutagenic response on tester strain TA 1535 with a resulting slope of 0.06 revertants/μg extract. At 400 μg/plate, TA 1538 responded with an average of 567 revertants/plate with a resulting slope of 1.40 revertants/μg. TA 98 exhibited a decreased mutagenic response to the sample when S9 was employed with an average of 1041 revertants/plate at a sample concentration of 400 μg/plate. The resulting slope was 2.66 revertants/μg of sample extract.

Table 3 illustrates the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 34 illustrated a strong mutagenic response in the absence of an S9 mix. At 200 μg/plate TA 98 showed an average of 2202 revertants/plate with a resulting slope of 10.76 revertants/μg of sample extract. Sample 35 had a slope of 7.36 revertants/μg of sample extract with an average of 1591 revertants at a sample concentration of 200 μg/plate. Sample 36 showed an average of 2190 revertants at a sample concentration of 200 μg/plate with a resulting slope of 9.82 revertants/μg of sample extract.

Table 3 also shows the results of the repeat bioassays on samples 34, 35, and 36 using tester strain TA 98 in the absence of a metabolic activation system.

The repeat study of sample 34 demonstrated a decreased mutagenic response when compared to the initial bioassay with a slope of 6.08 revertants/μg compared to 10.76 in the initial bioassay. Sample 35 exhibited an increased mutagenic response in TA 98 with a slope of 8.71 in the repeat study which compares favorably with the slope of 7.36 obtained in the inital bioassay. Finally, sample 36 demonstrated a decreased mutagenic response in the repeat bioassay with a resulting slope of 7.42 as compared to a slope of 9.82 obtained in the initial bioassay. Toxicity was observed in all samples at levels greater than 200 μg/plate.

Table 4 demonstrates the results of the duplicate bioassay of sample no. 33. The duplicate positive and negative controls are within experimental range for each tester strain as compared to the initial bioassay described in Table 2. In the repeat bioassay minus an S9 mix, TA 1535 showed a negative mutagenic response when exposed to sample No. 33. At a sample concentration of 200 μg/plate, 23 revertants/plate were observed. The slope for sample 33 in TA 1537, 2.49 was higher than that obtained in the initial bioassay, 1.72. The same sample minus S9 mix using TA 1538 demonstrated a slope of 5.85 in the repeat study which was nearly twice the slope of 2.60 observed in the initial bioassay. Nearly twice the number of mutants were observed in the repeat assay although the positive controls were nearly the same. In the repeat study, TA 98 elicited a lower mutagenic response to sample 33 in the absence of an S9 mix. A resulting slope of 3.19 revertants/μg of sample extract was obtained in the repeat study using TA 98 compared to a slope of 4.93 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated an identical weak response to sample no. 33, 0.06 revertant/μg, in the repeat

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TABLE 1. AMES BIOASSAY (RANGE-FINDING) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose, (µg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	27	16	29	24									27	28	28	28
Media Control		Yes	21	11	8	13									37	42	50	43
Solvent Control (Filter Blank)		No	22	29	25	25									30	30	25	28
Positive Controls																		
NaN$_3$		No	345	412	347	368												
9AA		No																
2NF		No													2102	1941	1927	1990
2AA		Yes	309	317	308	311									2580	2564	2575	2572
Sample No. 33	1	No	26	18		22									31	31		31
	10	No	24	19		22									56	53		55
	100	No	27	29		28									572	538		555
	500	No	13	19		16									2211	2368		2290
	1000	No	Toxicity												2229	2237		2233
	2000	No	Toxicity												1070	1148		1109
Revertants/µg extract[a]																		
Sample No. 33	1	Yes	16	17		17									45	41		43
	10	Yes	16	16		16									53	37		45
	100	Yes	27	25		26									171	160		166
	500	Yes	56	48		52									1212	1226		1219
	1000	Yes	38	38		38									1412	1776		1594
	2000	Yes	Toxicity												2245	1931		2088
Revertants/µg extract[a]																		

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[a] This value is the slope of the reqression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

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TABLE 2. AMES BIAOSSAY (INITIAL) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose, (µg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	15	18	12	15	7	9	5	7	14	17	15	15	22	25	19	22
Media Control		Yes	10	7	6	8					21	21	23	22	24	24	23	24
Solvent Control (Filter Blank)		No	19	13	9	14	8	6	5	6	19	13	7	13	24	18	22	21
Positive Controls																		
NaN_3		No	227	221	228	225												
9AA		No					740	973	780	831								
2NF		No									2089	1970	2075	2045	2017	1916	1932	1955
2AA		Yes	480	497	514	497					281	275	214	257	2581	2420	2461	2487
Sample No. 33	20	No	11	12	18	14	31	25	17	24	35	40	40	38	83	98	71	84
	60	No	12	23	15	17	46	54	52	51	90	86	78	85	297	264	249	270
	100	No	15	13	15	14	128	99	156	128	204	222	182	203	583	641	610	611
	200	No	29	27	29	28	298	310	355	321	524	460	483	489	1135	1230	1139	1168
	400	No	11	8	12	10[b]	331	317	380	343[b]	426	428	468	441[b]	2023	1915	1904	1947
	600	No	10	9	11	10[b]	346	317	321	328[b]	459	463	431	451[b]	2128	2329	2354	2270[b]
	1000	No	Toxicity				Toxicity				Toxicity				2042	2132	2108	2094[b]
Revertants/µg extract[a]						0.07				1.72				2.60				4.93
Sample No. 33	20	Yes	13	14	13	13					39	50	40	43	54	53	47	51
	60	Yes	13	20	15	16					78	54	63	65	129	123	106	119
	100	Yes	17	18	20	18					135	139	152	142	227	212	211	217
	200	Yes	23	43	32	33					264	248	260	257	550	483	490	508
	400	Yes	36	42	38	39					588	573	539	567	1119	1048	955	1041
	600	Yes	47	52	49	49					851	846	755	817[b]	1768	1575	1573	1639[b]
	1000	Yes	38	42	39	40[b]					1197	1177	1048	1141[b]	2543	2383	2227	2384[b]
Revertants/µg extract[a]						0.06								1.40				2.66

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[a] This value is the slope of the reqression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

TABLE 3. AMES BIOASSAY (INITIAL AND REPEAT WITHOUS S-9) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES WITH EM-329-F BASE FUEL DURING HFET, NYCC, AND 85 KPH

		TA 98, Number of Revertants Per Plate											
	Metabolic Activation,	HFET				NYCC				85 kph			
		Sample 34				Sample 35				Sample 36			
Dose, (µg)/plate	S-9	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial[c]													
20	No	249	252	286	262	275	285	228	263	363	393	419	392
60	No	720	708	732	720	589	580	525	565	919	800	989	903
100	No	1406	1101	1225	1244	919	789	827	845	1447	1345	1303	1365
200	No	2294	2173	2140	2202	1680	1514	1580	1591	2123	2211	2236	2190
400	No	2245	2886	2750	2627[b]	1886	1963	2021	1957[b]	2270	2466	2583	2440[b]
600	No	2646	2791	2593	2677[b]	1774	1742	1789	1768[b]	2344	2569	2629	2514[b]
1,000	No	2705	2711	2867	2761[b]	1058	981	1150	1063[b]	1076	1972	2003	1894[b]
Revertants/µg extract[a]					10.76				7.36				9.82
Repeat[d]													
20	No	222	200	237	220	260	325	290	292	349	333	321	334
60	No	413	444	405	421	576	636	634	615	799	802	765	789
100	No	683	699	669	684	1139	1114	1097	1117	1309	1302	1311	1307
200	No	1365	1331	1211	1302	1802	1891	1842	1845	1470	1796	1849	1705
400	No	1932	1998	1852	1927b	2278	2214	2214	2234[b]	2473	2306	2431	2403[b]
600	No	2083	1893	1906	1961[b]	2204	2327	2395	2309[b]	2099	2414	2371	2295[b]
1,000	No	1094	1508	1316	1306[b]	2416	2510	2634	2530[b]	1838	2119	2072	2010[b]
Revertants/µg extract[a]					6.08				8.71				7.42

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 2.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 4.

TABLE 4. AMES BIOASSAY (REPEAT) OF NATURALLY-ASPIRATED FIAT DIESEL (WITH CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-329-F BASE FUEL DURING FTP

Sample Identification	Dose, (µg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	42	23	23	29	12	17	8	12	16	8	10	11	38	20	32	30
Media Control		Yes	22	15	18	18					31	24	28	28	33	42	32	36
Solvent Control (Filter Blank)		No	34	26	32	31	18	11	11	13	16	12	18	15	17	28	21	22
Positive Controls																		
NaN_3		No	383	319	363	355												
9AA		No					733	418	426	526								
2NF		No									2335	2358	2255	2316	1885	1863	1784	1844
2AA		Yes	300	308	296	301					353	254	275	294	2503	2562	2401	2489
Sample No. 33	20	No	18	41	24	28	41	32	25	33	60	57	54	57	69	80	71	73
	60	No	33	20	31	28	85	71	102	86	188	170	209	189	193	198	209	200
	100	No	25	30	27	27	265	233	216	238	460	538	464	487	449	475	460	461
	200	No	28	30	10	23	477	422	499	466	1132	1094	1006	1077	994	945	956	965
	400	No	30	23	25	26[b]	364	433	444	414[b]	822	1014	1253	1030[b]	1352	1165	1261	1259
	600	No	11	9	28	16[b]	269	273	264	269[b]	684	417	513	538[b]	1925	2015	2059	2000[b]
	1000	No	Toxicity				Toxicity				Toxicity				1913	2083	1946	1981[b]
Revertants/µg extract[a]						-0.03				2.49				5.85				3.19
Sample No. 33	20	Yes	18	34	26	26					81	67	82	77	45	66	56	56
	60	Yes	20	27	40	29					235	202	196	211	89	98	91	93
	100	Yes	34	34	39	36					330	353	360	348	254	265	236	252
	200	Yes	42	46	42	43					654	588	615	619	549	528	466	514
	400	Yes	54	67	55	59					993	918	987	966	1135	1056	990	1060
	600	Yes	52	62	56	57					1436	1159	1125	1240[b]	1449	1604	1515	1523[b]
	1000	Yes	11	19	22	17[b]					827	774	819	807[b]	2231	1995	2035	2087[b]
Revertants/µg extract[a]						0.06								2.30				2.71

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[a] This value is the slope of the reqression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

study compared to the initial bioassay. TA 1538 in the presence of an S9 mix showed a mutagenic response to sample 33 that was greater than that observed in the initial bioassay. The resulting slope was 2.30 revertants/μg in the repeat study, compared to 1.40 in the initial bioassay. In addition, TA 98 exhibited a increased mutagenic response to sample 33 in the presence of an S9 mix. The resulting slope was 2.71 in the repeat study which compares favorably to 2.66 in the initial bioassay.

In summary, sample 33 was very weakly mutagenic in TA 1535 with metabolic activation; the absence of S9 reveals little or no mutagenic activity. A positive response was obtained in strain TA 1537 without activation. A positive response was also observed in TA 1538 and TA 98 both with and without metabolic activation. In TA 1538 and in TA 98, S9 decreased mutagenic activity. Samples 34, 35, and 36 were mutagenic in TA 98 without metabolic activation.

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December 9, 1981

Final Report

3B469

In Vitro Ames *Salmonella*/microsomal Mutagenicity Assay of Four Samples Received from Southwest Research Institute and Generated from a Fiat Turbocharged Diesel (with underfloor catalytic trap) using Fuel EM-469-F

Submitted by:

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Introduction

Southwest Foundation for Research and Education examined four samples for mutagenicity using the Ames Salmonella typhimurium bioassay. The samples were received on November 5, 1981, and were identified as sample 37 (FTP 723) with a weight of 0.192871 g, sample 38 (HFET 726) with a weight of 0.035294 g, sample 39 (NYCC 728) with a weight of 0.047145 g, and sample 40 (85 kph 731) with a weight of 0.031133 g. An Aroclor 1254-stimulated rat liver homogenate metabolic activation system (S9 mix) was included in sample 37 using tester strains TA 98, TA 1535, and TA 1538. In addition, sample 37 was tested in the absence of an S9 mix using tester strains TA 98, TA 1535, TA 1537, and TA 1538. Samples No. 38, 39, and 40 were tested using tester strain TA 98 in the absence of a metabolic activation system.

All samples were dissolved in dimethyl sulfoxide (DMSO) and tested at seven levels of sample concentration consisting of 20, 60, 100, 200, 400, 600, and 1000 µg/plate. Each sample concentration was tested in triplicate with and without an S9 mix and on specific tester strains as indicated in the above paragraph. A complete set of positive and negative controls was incorporated into the bioassay to demonstrate that the system was working within optimum ranges. Finally, a duplicate bioassay of the above samples and controls was conducted as a standard procedure to compare and evaluate the data.

Results

A range finding study was conducted on sample no. 37 in tester strains TA 98 and TA 1535. The range finding study as shown in Table 1 disclosed that sample no. 37 was reactive in tester strain TA 98, both with and without metabolic activation, although the reactivity was enhanced by the presence of metabolic activating enzymes. The sample was toxic to the tester organisms at 2000 µg/ plate. Consequently, it was determined that an upper limit of 1000 µg/plate would be appropriate for definitive testing, and a range of concentrations from 20 to 1000 µg/plate was selected. In TA 1535, no mutagenicity was observed without metabolic activation. Using an S9 fraction for metabolic activation, increased mutagenic activity was observed. Again, toxicity was observed at 2000 µg/plate.

In the initial bioassay, the results indicate that the negative and positive controls are within the optimum range established for our laboratory. The known positive mutagens which we routinely use on specific tester strains with and without an S9 mix clearly illustrate the ability of the tester strains to incorporate mutagens into their genetic structure, causing a significant increase in the number of revertants over the negative controls (Tables 2 and 4).

In Table 2, sample no. 37 showed a negative mutagenic response in tester strain TA 1535 when exposed to the seven chemical levels in the absence of an S9 fraction; toxicity was observed at 600 µg/plate. TA 1537 minus S9 demonstrated a greater mutagenic response than TA 1535 with a resulting slope of 1.27 revertants/µg extract. Toxicity was also observed at levels above 400 µg/plate. TA 1538 minus S9 showed a greater mutagenic response than both TA 1537 and TA 1535. At 400 µg/plate, there was an average of 1120 revertants/plate. The

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TABLE 1. AMES BIOASSAY (RANGE-FINDING) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose, (µg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	42	23	23	29									38	20	32	30
Media Control		Yes	22	15	18	18									33	42	32	36
Solvent Control (Filter Blank)		No	34	26	32	31									17	28	21	22
Positive Controls																		
NaN_3		No	383	319	363	355												
9AA		No																
2NF		No													1885	1863	1784	1844
2AA		Yes	300	308	296	301									2503	2562	2401	2489
Sample 37	1	No	28	22		25									30	33		32
	10	No	32	33		33									40	42		41
	100	No	26	22		24									417	342		380
	500	No	17	30		24									1526	1409		1468
	1000	No	8	15		12									1777	1718		1748
	2000	No	Toxicity												1710	1411		1561[b]
Revertants/µg extract[a]																		
Sample 37	1	Yes	19	29		24									41	42		42
	10	Yes	17	21		19									57	57		57
	100	Yes	32	22		27									196	195		196
	500	Yes	47	54		51									1015	1003		1009
	1000	Yes	35	29		32									1820	1673		1747
	2000	Yes	Toxicity												2154	2071		2113[b]
Revertants/µg extract[a]																		

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[a] This value is the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

TABLE 2. AMES BIOASSAY (INITIAL) OF TUROBCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose, (µg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	19	21	13	18	6	4	6	5	14	9	13	12	9	10	17	12
Media Control		Yes	10	12	16	13					24	23	19	22	15	32	27	25
Solvent Control (Filter Blank)		No	17	11	18	15	10	8	5	8	16	14	10	13	14	15	17	15
Positive Controls																		
NaN_3		No	210	204	221	212												
9AA		No					1653	1913	1725	1764								
2NF		No									2186	2030	2048	2088	1383	1560	1489	1477
2AA		Yes	219	232	183	211					2097	2252	2192	2180	1838	2042	1934	1940
Sample 37	20	No	30	19	22	24	21	18	15	18	41	42	46	43	44	58	48	50
	60	No	22	13	19	18	56	49	42	49	148	152	149	150	174	192	131	166
	100	No	17	16	12	15	91	91	80	87	353	356	356	355	305	353	289	316
	200	No	18	15	16	16	214	219	234	222	747	651	706	701	629	592	543	588
	400	No	26	18	14	19	500	483	481	488	1148	1100	1113	1120	1140	1126	994	1087
	600	No	18	26	19	21[b]	518	533	567	539[b]	1125	1240	1137	1167[b]	1510	1504	1449	1488[b]
	1000	No	12	13	17	14[b]	281	321	297	300[b]	387	408	380	392[b]	1567	1664	1646	1626[b]
Revertants/µg extract[a]						-0.01				1.27				2.86				2.72
Sample 37	20	Yes	19	18	19	19					88	76	80	81	57	52	51	53
	60	Yes	18	15	12	15					235	237	211	228	134	128	124	129
	100	Yes	19	21	23	21					353	343	331	342	232	255	200	229
	200	Yes	18	15	19	17					662	628	620	637	446	444	445	445
	400	Yes	33	32	33	33					1282	1113	1082	1159	905	1023	964	964
	600	Yes	46	51	47	48					1339	1612	1483	1478[b]	1508	1435	1400	1448
	1000	Yes	22	29	30	27[b]					1424	1396	1385	1402[b]	1901	1906	1241	1683[b]
Revertants/µg extract[a]						0.05								2.80				2.43

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[a] This value is the slope of the reqression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

resulting slope was 2.86 revertants/µg of sample extract. Toxicity was observed at higher levels of extract. In the absence of S9 mix, TA 98 demonstrated a slightly lower mutagenic response to the above sample than TA 1538. At 400 µg/plate there was an average of 1087 revertants/plate with a resulting slope of 2.72 revertants/µg of sample extract.

In the presence of an activation system, decreased mutagenicity was observed for sample no. 37 in strains TA 1538 and TA 98. Sample no. 37 illustrated a very weak mutagenic response on tester strain TA 1535 with a resulting slope of 0.05 revertants/µg extract. At 400 µg/plate, TA 1538 responded with an average of 1159 revertants/plate with a resulting slope of 2.80 revertants/µg. TA 98 exhibited a decreased mutagenic response to the sample when S9 was employed with an average of 964 revertants/plate at a sample concentration of 400 µg/plate. The resulting slope was 2.43 revertants/µg of sample extract.

Table 3 illustrates the results obtained from the other three samples tested using TA 98 in the absence of a metabolic activation system. In the initial bioassay, sample 38 illustrated a strong mutagenic response in the absence of an S9 mix. At 200 µg/plate TA 98 showed an average of 1715 revertants/plate with a resulting slope of 8.53 revertants/µg of sample extract. Sample 39 had a slope of 1.55 revertants/µg of sample extract with an average of 621 revertants at a sample concentration of 400 µg/plate. Sample 40 showed an average of 1879 revertants at a sample concentration of 200 µg/plate with a resulting slope of 8.96 revertants/µg of sample extract.

Table 3 also shows the results of the repeat bioassays on samples 38, 39, and 40 using tester strain TA 98 in the absence of a metabolic activation system.

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TABLE 3. AMES BIOASSAY (INITIAL AND REPEAT WITHOUT S-9) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES WITH EM-469-F FUEL DURING HFET, NYCC, AND 85 KPH

Dose, (µg)/plate	Metabolic Activation, S-9	TA98, Number of Revertants Per Plate											
		HFET				NYCC				85 kph			
		Sample 38				Sample 39				Sample 40			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Initial^c													
20	No	186	208	201	198	43	39	38	40	239	275	265	260
60	No	499	473	516	496	86	98	97	94	674	630	616	640
100	No	1048	943	924	972	131	137	137	135	1092	1004	892	996
200	No	1874	1681	1590	1715	303	291	310	301	2024	1788	1825	1879
400	No	2336	2408	2357	2367^b	687	546	629	621	2330	2432	2470	2411^b
600	No	2737	2631	2641	2670^b	840	846	639	775^b	2684	2720	2652	2685^b
1000	No	2658	2673	2678	2670^b	800	874	821	832^b	2067	2184	2089	2113^b
Revertants/µg extract^a					8.53				1.55				8.96
Repeat^d													
20	No	201	247	187	212	45	46	36	42	285	344	303	311
60	No	542	470	518	510	98	91	90	93	783	813	821	806
100	No	930	884	850	888	159	164	151	158	1042	1188	1141	1124
200	No	1877	1774	1743	1798	392	364	338	365	1955	1834	1981	1923
400	No	2127	2458	2471	2453^b	580	585	593	586	2479	2289	2437	2402^b
600	No	2722	2744	2617	2694^b	876	806	746	809^b	2693	2576	2596	2622^b
1000	No	2484	2448	2393	2442^b	853	859	853	855^b	2162	2244	1647	2018^b
Revertants/µg extract^a					8.91				1.47				8.72

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

[c] Initial TA-98 media, solvent, and positive controls used as per Table 2.

[d] Repeat TA-98 media, solvent, and positive controls used as per Table 4.

The repeat study of sample 38 demonstrated an increased mutagenic response when compared to the initial bioassay with a slope of 8.91 revertants/μg compared to 8.53 in the initial bioassay. Sample 39 exhibited a decreased mutagenic response in TA 98 with a slope of 1.47 in the repeat study which compares favorably with the slope of 1.55 obtained in the inital bioassay. Finally, sample 40 demonstrated a decreased mutagenic response in the repeat bioassay with a resulting slope of 8.72, compared to a slope of 8.96 obtained in the initial bioassay. Toxicity was observed in samples 38 and 40 at levels greater than 200 μg/plate; sample 39 was toxic at levels above 400 μg/plate.

Table 4 demonstrates the results of the duplicate bioassay of sample no. 37. The duplicate positive and negative controls are within experimental range for each tester strain as compared to the initial bioassay described in Table 2. In the repeat bioassay minus an S9 mix, TA 1535 showed a mutagenic response slightly above background when exposed to sample No. 37. At a sample concentration of 400 μg/plate, 30 revertants/plate were observed. The slope for sample 33 in TA 1537, 1.31 was nearly identical to that obtained in the initial bioassay, 1.27. The same sample minus S9 mix using TA 1538 demonstrated a slope of 2.23 in the repeat study which was nearly identical to the slope of 2.86 observed in the initial bioassay. In the repeat study, TA 98 elicited a higher mutagenic response to sample 37 in the absence of an S9 mix. A resulting slope of 2.95 revertants/μg of sample extract was obtained in the repeat study using TA 98 compared to a slope of 2.72 in the initial bioassay.

In the presence of a metabolic activation system, the above sample results compared favorably with the results of the initial bioassay. TA 1535 illustrated similar weak response to sample no. 37, 0.08 revertant/μg, in the repeat study

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TABLE 4. AMES BIOASSAY (REPEAT) OF TURBOCHARGED FIAT DIESEL (WITH UNDERFLOOR CATALYTIC TRAP) EXHAUST PARTICULATE ORGANIC SOLUBLES OBTAINED WITH EM-469-F FUEL DURING FTP

Sample Identification	Dose, (μg)/plate	Metabolic Activation, S-9	Number of Revertants Per Plate															
			TA 1535				TA 1537				TA 1538				TA 98			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
Media Control		No	30	24	26	27	13	7	8	9	13	6	12	10	16	9	17	14
Media Control		Yes	8	20	17	15					20	22	21	21	27	30	30	29
Solvent Control (Filter Blank)		No	20	23	25	23	9	7	8	8	13	22	14	16	21	17	21	20
Positive Controls																		
NaN_3		No	314	298	326	313												
9AA		No					1721	1357	1758	1612								
2NF		No									2491	2385	2574	2483	1937	1891	2100	1976
2AA		Yes	249	336	305	297					2123	1996	2034	2051	1773	1615	1659	1682
Sample 37	20	No	29	24	21	25	27	26	27	27	53	64	55	57	42	59	54	52
	60	No	20	25	22	22	58	76	70	68	157	167	144	156	162	177	165	168
	100	No	29	24	26	26	122	131	124	126	226	333	249	269	419	397	328	381
	200	No	32	27	20	26	288	333	279	300	525	540	433	499	683	619	647	650
	400	No	31	26	32	30	540	530	472	514	951	941	836	909	1256	1196	1096	1183
	600	No	22	19	28	23[b]	526	516	437	493[b]	1151	1160	969	1093[b]	1580	1462	1394	1479[b]
	1000	No	13	17	15	15[b]	401	341	434	392[b]	796	898	811	835[b]	1586	1647	1681	1638[b]
Revertants/μg extract[a]						0.01				1.31				2.23				2.95
Sample 37	20	Yes	14	20	13	16					99	93	84	92	66	45	60	57
	60	Yes	14	13	24	17					232	226	203	220	137	127	130	131
	100	Yes	21	21	32	25					341	324	322	329	248	241	214	234
	200	Yes	27	32	43	34					653	684	633	657	420	463	427	437
	400	Yes	68	50	52	57					1188	1183	1187	1186	1010	983	976	990
	600	Yes	61	46	59	55					1604	1595	1556	1585[b]	1491	1392	1422	1435
	1000	Yes	33	30	36	33[b]					1620	1587	1536	1581[b]	2124	2158	2115	2132[b]
Revertants/μg extract[a]						0.08								2.88				2.42

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[a] This value is the slope of the regression line based on various extract dose levels and does not identify response at a particular extract since the response is not completely linear over the entire concentration used.

[b] Not included in slope determination.

compared to 0.05 in the initial bioassay. TA 1538 in the presence of an S9 mix showed a mutagenic response to sample 37 that was similar to that observed in the initial bioassay. The resulting slope was 2.88 revertants/µg in the repeat study, compared to 2.80 in the initial bioassay. In addition, TA 98 exhibited a decreased mutagenic response to sample 37 in the presence of an S9 mix. The resulting slope was 2.42 in the repeat study which is nearly identical to 2.43 obtained in the initial bioassay.

In summary, sample 37 was very weakly mutagenic in TA 1535 with metabolic activation; the absence of S9 reveals little or no mutagenic activity. A positive response was obtained in strain TA 1537 without activation. A positive response was also observed in TA 1538 and TA 98 both with and without metabolic activation. In TA 98, S9 decreased mutagenic activity. Samples 38, 39, and 40 were mutagenic in TA 98 without metabolic activation.

TECHNICAL REPORT DATA

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1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
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7. AUTHOR(S) D.A. Montalvo, and C.T. Hare		8. PERFORMING ORGANIZATION REPORT NO.
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15. SUPPLEMENTARY NOTES		

16. ABSTRACT

Emissions from three diesel cars using two fuel formulations were assessed. The three diesel cars included a prototype naturally-aspirated Fiat 131, a prototype turbocharged Fiat 131, and a 1981 Oldsmobile Cutlass Supreme. Each Fiat was tested with and without a prototype catalytic trap. Vehicle operating procedures used for test purposes included the 1981 Federal Test Procedures as well as the Highway Fuel Economy Test, the New York City Cycle, and an 85 km/hr steady-state cruise. Both regulated and unregulated gaseous and particulate emissions were measured. Organic solubles in particulate were analyzed for various constituents and characteristics including fractionation by relative polarity, benzo(a)pyrene (BaP), and mutagenic activity by Ames bioassay.

Application of the catalytic trap oxidizer system to the Fiat prototypes resulted in significant reductions of organic and carbon monoxide emissions under all transient driving conditions examined. Total particulate emissions were reduced an average of 55 percent with the turbocharged engine and 65 percent with the naturally-aspirated engine. The Ames assay mutagenic response (revertants/μg) of the particulate phase organics was elevated by the catalytic exhaust aftertreatment device, however the emission rates (revertants/km) were reduced an average of 66 percent with the turbocharged and 73 percent with the naturally-aspirated engines.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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